Appendix G. Kings Beach Watershed Improvement Project Final Hydrologic Conditions Report

Kings Beach Watershed Improvement Project

Final
Hydrologic Conditions Report




Prepared for:

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Truckee, CA 96161

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February 2006

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for

Kings Beach Water Quality Improvement Project

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This report describes the existing hydrologic conditions in the Kings Beach Watershed Improvement Program (WIP) area. The WIP is a component of the Kings Beach Commercial Core Improvement Project (CCIP) which is focused on improving transportation facilities, aesthetics, and storm water quality within the Kings Beach Commercial Core area. Reducing erosion and runoff from the WIP area and providing more opportunities for infiltration and treatment will improve stormwater runoff to Lake Tahoe.

This report describes the estimated annual runoff from the Kings Beach area and also the runoff from specific storm events at various locations in the watersheds. Furthermore, the report summarizes field observations of pollutant sources.

Data sources used in the analysis include the Tahoe Basin soil survey, estimates of impervious surface developed by Desert Research Institute, the Placer County Stormwater Management Manual, field observations of runoff patterns and characteristics, and runoff estimation tools such as HEC-HMS and the SWQIC spreadsheet models.

The WIP area is comprised of two main watersheds: Griff Creek and Kings Beach. The Kings Beach is further subdivided into the Deer, Bear, Coon, Fox, Beaver, and Park subbasins. The annual runoff characteristics were assessed using these subbasins.

ANNUAL RUNOFF

Using the SWQIC runoff spreadsheet (SWQIC 2004), the annual runoff characteristics of the basins were estimated. The model uses historic rainfall and generalized watershed conditions. Data for the model were developed from the GIS database of land use, impervious surfaces, and soils in the area.

The statistical results of the hydrology spreadsheet model are summarized below.

Mean Annual Precipitation	=	26 inches[1]
Average Event Volume	=	0.29 inches
Average Event Duration	=	6.08 hours
Average Inter-Event Duration	=	74.25 hours
Average Number of Events per Year	=	74.2

(1 – Source: Oregon State University, 2002)

	Exceedance Probability		
	5%	**10%**	**50%**
Intensity, in/hr	0.26	0.18	0.09
Volume, in	1.24	0.81	0.18

EVENT-BASED RUNOFF

The response of the WIP area to specific rainfall events was estimated with the model HEC-HMS. Model parameters were estimated from field observations and the Placer County Stormwater Management Manual. The seven subbasins in the Kings Beach watershed were further subdivided to reflect specific hydrologic controls.

Simulations were performed for the following events:

- 2-year, 1-hour storm
- 2-year, 72-hour storm
- 25-year, 1-hour storm
- 25-year, 72-hour storm

Model results indicate that runoff from the Griff Creek watershed had the largest runoff peak and volume for the specific events (Table ES-1 and Table ES-2).

Table ES-1. Total Runoff Volume for Simulated Storms (acre-feet).

Sub-Basin[1]	2-Year / 1-Hour	2-Year / 72-Hour	25-Year / 1-Hour	25 Year / 72-Hour
Griff Creek Outlet	2.0	513.4	4.4	1770.4
Deer Outlet	1.0	13.8	2.4	36.2
Bear Outlet	0.5	26.0	2.1	73.0
Coon Outlet	1.0	62.7	3.6	171.8
Fox Outlet	0.9	13.5	2.6	39.9
Beaver Outlet	0.4	19.2	1.2	54.4
Lakefront Basins				
Secline 1 Outlet	0.1	4.4	0.2	9.5
Brockway 1 Outlet	0.0	2.1	0.1	4.7
Brockway 2 Outlet	0.1	4.4	0.3	9.6
Fox 3b Outlet	0.0	1.7	0.1	3.8
Park 1 Outlet	0.7	48.0	3.0	108.8
Park 2 Outlet	0.2	6.8	0.5	14.5

1 – Outlet refers to the total watershed contributing to Lake Tahoe. For example, Griff Outlet is the contribution of the entire Griff Creek watershed to the lake.

Table ES-2. Peak Discharge for the Simulated Storms.

Sub-Basin[1]	2-Year / 1-Hour Peak Flow (cfs)	2-Year / 1-Hour Time to Peak (min)	2-Year / 72-Hour Peak Flow (cfs)	2-Year / 72-Hour Time to Peak (min)	25-Year / 1-Hour Peak Flow (cfs)	25-Year / 1-Hour Time to Peak (min)	25 Year / 72-Hour Peak Flow (cfs)	25 Year / 72-Hour Time to Peak (min)
Griff Outlet	18.4	68	329.1	810	53.8	50	1199.6	805
Deer Outlet	18.8	48	18.3	720	50.4	44	41.0	720
Bear Outlet	13.2	78	30.0	720	48.0	54	76.8	720
Coon Outlet	27.4	92	69.5	750	125.4	68	169.5	745
Fox Outlet	21.2	54	22.1	725	62.2	44	50.4	720
Beaver Outlet	10.8	64	22.9	720	28.7	44	60.1	720
Lakefront Basins								
Secline 1 Outlet	1.0	60	4.4	720	5.2	34	9.1	720
Brockway 1 Outlet	0.4	60	2.2	720	2.1	36	4.5	720
Brockway 2 Outlet	1.4	32	4.4	720	5.7	36	9.1	720
Fox 3b Outlet	0.4	30	1.8	720	2.2	32	3.6	720
Park 1	13.5	60	46.2	720	74.7	32	96.9	720
Park 2	3.2	32	6.7	720	10.5	34	13.7	720

1 – Outlet refers to the total watershed contributing to Lake Tahoe. For example, Griff Outlet is the contribution of the entire Griff Creek watershed to the lake.

Land use conditions for the WIP area data were estimated from the GIS database and field observations. The land use conditions and the results of the annual hydrograph spreadsheet model were utilized in the SWQIC water quality spreadsheet. The spreadsheet model estimated pollutant loading based on land use, runoff conditions, and the connection between land areas and discharge points (Table ES-3). The results indicate that while the Griff Creek watershed produces the largest volume of sediment and other pollutants, the pollutant loading as a function of contributing area is the smallest. The Coon subbasin produces the highest suspended sediment load per acre. The Bear and Park subbasins also produce significant sediment loads relative to contributing area.

Potential sources of sediment and other pollutants were identified through extensive field analysis of the WIP area.

Table ES-3. Results of the Water Quality Loading Analysis.

	Pollutant Load (tons/year)						
Water Quality Parameter	**Griff**	**Deer**	**Bear**	**Coon**	**Fox**	**Beaver**	**Park**
NO3	0.006	0.002	0.002	0.006	0.003	0.002	0.003
TKN	0.155	0.017	0.018	0.051	0.022	0.016	0.021
SRP	0.020	0.002	0.002	0.007	0.002	0.002	0.003
TP	0.052	0.011	0.009	0.027	0.014	0.010	0.010
TSS	6.889	3.804	2.733	7.666	4.670	3.006	3.136
Watershed Area (acres)	2815.29	61.09	133.15	355.79	82.61	94.10	125.29
TSS Loading (lbs/acre)	4.9	124.5	41.1	43.1	113.1	63.9	50.1

Source: SWQIC 2004.

1.0
INTRODUCTION

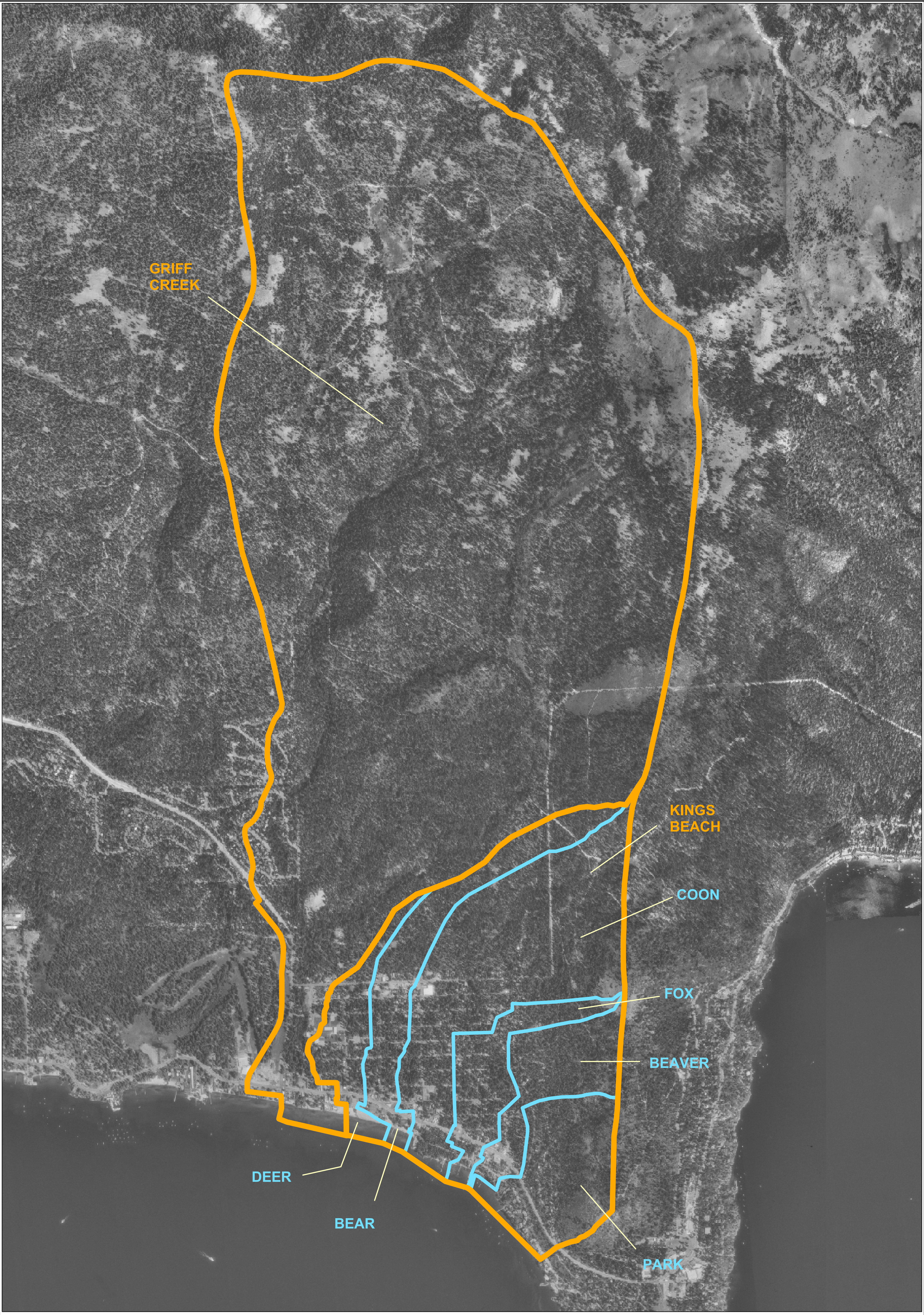
The purpose of this report is to present current hydrologic conditions and potential pollutant sources for the Kings Beach Watershed Improvement Project (WIP). The goal of the WIP is to improve the water quality of runoff reaching Lake Tahoe by reducing pollutant sources, mostly sediment and nutrients, originating in the WIP area.

The WIP is a component of the Kings Beach Commercial Core Improvement Project (CCIP) which is focused on improving transportation facilities, aesthetics, and storm water quality within the Kings Beach Commercial Core area. Lake Tahoe's clarity is decreasing as a result of sediment and nutrient loading. Fine sediment particles remain suspended in the water column, scattering light and reducing clarity. Nutrients, particularly phosphorus and nitrogen, stimulate the production of algae, which also reduces lake clarity. Often times, phosphorus is adsorbed onto fine sediments. Reducing erosion and runoff from disturbed soils and providing more opportunities for infiltration and treatment can improve stormwater runoff and ultimately the clarity of Lake Tahoe.

The Lake Tahoe Basin is comprised of 63 major watersheds, as defined by the Tahoe Regional Planning Agency (TRPA), that drain to Lake Tahoe. The WIP area encompasses two major TRPA-delineated watersheds: Kings Beach, which is an intervening zone, and Griff Creek. The WIP area is comprised of 2,815 acres in the Griff Creek watershed and 852 acres in the Kings Beach watershed (Figure 1.0). Griff Creek begins at Martis Peak and flows to the lake. It flows year-round including the dry fall period. The Kings Beach Watershed includes undeveloped forest and the urban area. It contains several ephemeral watercourses. The WIP area includes the Kings Beach CCIP, the County subdivision area in Kings Beach, and U.S. Forest Service (USFS) land up-gradient of the urbanized development.

This report expands on existing conditions information provided by Harding ESE and MACTEC Engineering Consultants, Inc. from 2002 to 2003. Work completed includes a subwatershed map and a general assessment of pollutant sources by parcel number categorizing the sources as non-source, minor source, source and major source (Harding ESE 2002). Numerous sites for potential water quality improvements were identified and evaluated according to various parameters, and 14 water quality concept alternatives were proposed, of which four were ultimately chosen by the Technical Advisory Committee (TAC) for further consideration (MACTEC 2003).

Previous work was completed outside of the Storm Water Quality Improvement Committee's (SWQIC) Guidelines adopted by the California Tahoe Conservancy in 2001 (SWQIC 2004). The SWQIC Guidelines recommend a watershed approach when designing water quality projects in order to define a broad range of opportunities for water quality improvements and to clearly define constraints. The preferred design approach under SWQIC has three phases: Analyze Existing Conditions, Formulate and Evaluate Alternatives, and Select and Develop a Recommended Alternative. The WIP work to date completed the Formulate Alternatives phase; however, to better evaluate and validate the alternatives following the preferred design approach, additional existing condition information on hydrology and pollutants is provided in this report. The results of this report will be used to evaluate proposed water quality improvement alternatives, identify additional opportunities for water quality benefits and evaluate volume and sizing requirements for treatment structures during the Evaluation of Alternatives Phase. Methods available to improve water quality include source control, hydrologic design and treatment, with a priority given to source control. A comprehensive geomorphic assessment of Griff Creek and Coon Street stream environment zone (SEZ) will be provided in a separate report.



Watershed Boundary

Primary Watershed

Sub Watersheds

ENTRIX

Watershed Boundaries
in the Project Area

Figure 1.0

0 1,200 2,400
Feet

7/22/05

Projection: UTM Zone 10 N
Datum: NAD 83

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This report was compiled after completing several field and modeling tasks. First, a detailed drainage conveyance map was developed by gathering information on topography, existing drainage conveyances and outfall concentration points. Land use, soil and impervious area data were compiled and used to calculate peak flows and hydrographs for design storm events. In addition, these data were used to compute flow duration curves and characteristics for each sub-basin in the WIP area. Sediment and nutrient source areas within the WIP area were identified, delineated and mapped. This information was compiled, and an assessment was conducted to identify drainage problems, pollutant sources and existing Best Management Practices (BMPs).

2.1 METHODOLOGY

Annual runoff and pollutant loading from the WIP area were evaluated using the spreadsheet models developed by the SWQIC, (SWQIC 2004), for analyzing water quality projects in the Lake Tahoe Basin. The hydrology spreadsheet addresses the annual hydrologic response of a watershed based on conditions such as pervious area, connectivity of impervious surfaces and rainfall patterns. The water quality model estimates pollutant loading based on the land use of a watershed and the runoff pattern generated by the first model. Input data for both models was developed through field analysis of drainage patterns, hydraulic facilities and land use, along with topographic maps. The hydrology spreadsheet was run for the different sub-basins, and the results were entered into the water quality spreadsheet.

2.2 WATERSHED CHARACTERISTICS

The major drainage areas in the Kings Beach WIP area are the Griff Creek and Kings Beach watersheds. Rainfall runoff and snowmelt from the Griff Creek watershed flows to Griff Creek and eventually to Lake Tahoe, near the intersection of State Routes 267 and 28. The watershed begins at Martis Peak at an elevation of 8,742 feet. The Kings Beach watershed is a combination of several subwatersheds that originate in the open forestland north and east of the community of Kings Beach and flow to Lake Tahoe at several points within the area.

Although the Griff and Kings Beach watersheds account for the entire drainage area tributary to Lake Tahoe at the community of Kings Beach, these large watersheds are subdivided to assess runoff characteristics more accurately. Because watershed characteristics such as land use, slope and soils range greatly throughout the watersheds, the watersheds were subdivided into smaller drainage units for hydrologic and water quality analysis. These sub-watersheds are described in Section 2.2.1.

2.2.1 SUB-BASINS

For the hydrologic analysis, the Griff Creek and Kings Beach watersheds were divided into seven drainage basins. Each drainage basin reflects a continuous flow path from the surrounding forestland to the lake. The drainage basins are summarized in Table 2.1 and shown in Figure 1.0. A more detailed map showing drainage infrastructure and pollutant source areas is introduced in Section 4.0 (Appendix F).

Drainage basins were delineated to reflect drainage concentration points, land uses and drainage patterns. The upstream contributing area for each drainage basin is primarily forestland with little or no impervious surface, while the downstream area is the developed area within the Kings Beach community. Along the State Route 28 corridor, land use is commercial. Behind the

Table 2.1. Watersheds and Drainage Basins in the WIP Area.

Drainage Basin	Description
Griff Creek Watershed	
Griff	Headwaters of basin in national forest. High elevation with some residential. Flows to residential and commercial areas in Kings Beach. Includes impervious surfaces for streets, homes, parking lots and buildings. Pervious areas include forestland, golf course, beachfront and vacant parcels.
Kings Beach Watershed	
Deer	Headwaters of basin in national forest. Flows to residential and commercial areas in Kings Beach. Includes impervious surfaces for streets, homes, parking lots, school and buildings. Pervious areas include forestland, beachfront and vacant parcels.
Bear	Headwaters of basin in national forest. Medium to high elevation. Flows to residential and commercial areas in Kings Beach. Includes impervious surfaces for streets, homes, parking lots and buildings. Some commercial property at forest/urban boundary. Pervious areas include forestland, beachfront and vacant parcels.
Coon	Headwaters of basin in national forest. Medium to high elevation with some residential. Flows to residential and commercial areas in Kings Beach. Includes impervious surfaces for streets, homes, parking lots and buildings. Pervious areas include forestland, beachfront and vacant parcels.
Fox	Headwaters of basin in national forest. Medium to high elevation with some residential at forest boundary. Flows to residential and commercial areas in Kings Beach. Includes impervious surfaces for streets, homes, parking lots and buildings. Pervious areas include forestland, beachfront and vacant parcels.
Beaver	Headwaters of basin in national forest. Medium to high elevation with some residential. Flows to residential and commercial areas in Kings Beach. Includes impervious surfaces for streets, homes, parking lots and buildings. Pervious areas include forestland and vacant parcels.
Park	Headwaters of basin in national forest. Medium to high elevation with some residential. Flows to residential and commercial areas in Kings Beach. Includes impervious surfaces for streets, homes, parking lots and buildings. Pervious areas include forestland, beachfront and vacant parcels.

commercial land is a mixture of single family and multi-family residences. Commercial land and open space lie between the highway and Lake Tahoe.

Stormwater from the upgradient forest appears to be conveyed in defined channels or as overland flow. Griff Creek is the primary channel and has a steep slope and medium to high vegetation cover.

The urban area is a mixture of paved and unpaved surfaces. Runoff is conveyed in open ditches, curb and gutter and subsurface storm drains. Runoff is conveyed under State Route 28 and discharged to the lake through a series of culverts. Several detention basins have been constructed within the urban drainage area to control runoff and pollutant discharge.

2.2.2 SOILS

Soils in the watershed were classified according to the Natural Resources Conservation Service (NRCS) hydrologic soil types. Hydrologic soil types are labeled as type A, B, C or D and are identified in the Lake Tahoe Basin Soil Survey (NRCS 1974). The soils map for the region and the immediate WIP area are shown in Figure 2.1 and Table 2.2. The Hydrologic Soil Groups are:

Type A - Low runoff potential. Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well to excessively drained sands or gravels. These soils have a high rate of water transmission.

Type B - Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

Type C - Soils having slow infiltration rates when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.

Type D - High runoff potential. Soils having very slow infiltration rates when thoroughly wetted and consisting chiefly of clay soils with high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

Table 2.2. Hydrologic Soil Types in the WIP Area (acres).

	Drainage Basin						
	Griff	**Deer**	**Bear**	**Coon**	**Fox**	**Beaver**	**Park**
Total Area (ac)	2815.29	61.09	133.15	355.79	82.61	94.10	125.29
Soil Type							
A	16.8	1.5	15.8	6.2	4.0	1.9	9.3
B	848.1	9.0	27.4	13.7	0.0	0.0	0.0
C	1534.6	45.5	90.0	317.3	77.0	83.8	78.7
D	415.8	5.2	0.0	18.6	1.6	8.4	37.2

Watershed Boundary

Secondary Watershed

Hydro Class

A

B

C

D

E N T R I X

Soils by Hydro Class
in the Project Area

Figure 2.1

0 625 1,250 1,875 2,500
Feet

Projection: UTM Zone 10 N
Datum: NAD 83

7/25/05

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2.2.3 Impervious Area

The TRPA mapped impervious areas in the Lake Tahoe Basin in GIS. Impervious surface areas for each drainage basin were computed by superimposing basin boundaries onto these GIS data layers. The amount of impervious area is an important factor in the generation of runoff and pollutant load estimates as impervious surfaces such as pavement and rooftops cover soils that would otherwise infiltrate rainfall. Nearly all of the precipitation falling on impervious surfaces will run off and collect in drainage facilities and ultimately reach Lake Tahoe. Impervious surfaces in the right-of-way (ROW) are also a collection point for sediment and other pollutants that will wash into the drainage system during rainfall or snowmelt events. Impervious areas for the drainage basins are described in Table 2.3 and Figure 2.2.

Table 2.3. Impervious Areas for Drainage Basins used in the Annual Hydrologic Model.

	Drainage Basin						
Model Parameter	**Griff**	**Deer**	**Bear**	**Coon**	**Fox**	**Beaver**	**Park**
Drainage Area (acres)	2815.29	61.09	133.15	355.79	82.61	94.10	125.29
Impervious Area (acres)	40.82	21.16	22.37	38.64	19.41	10.95	14.90

Source: TRPA database

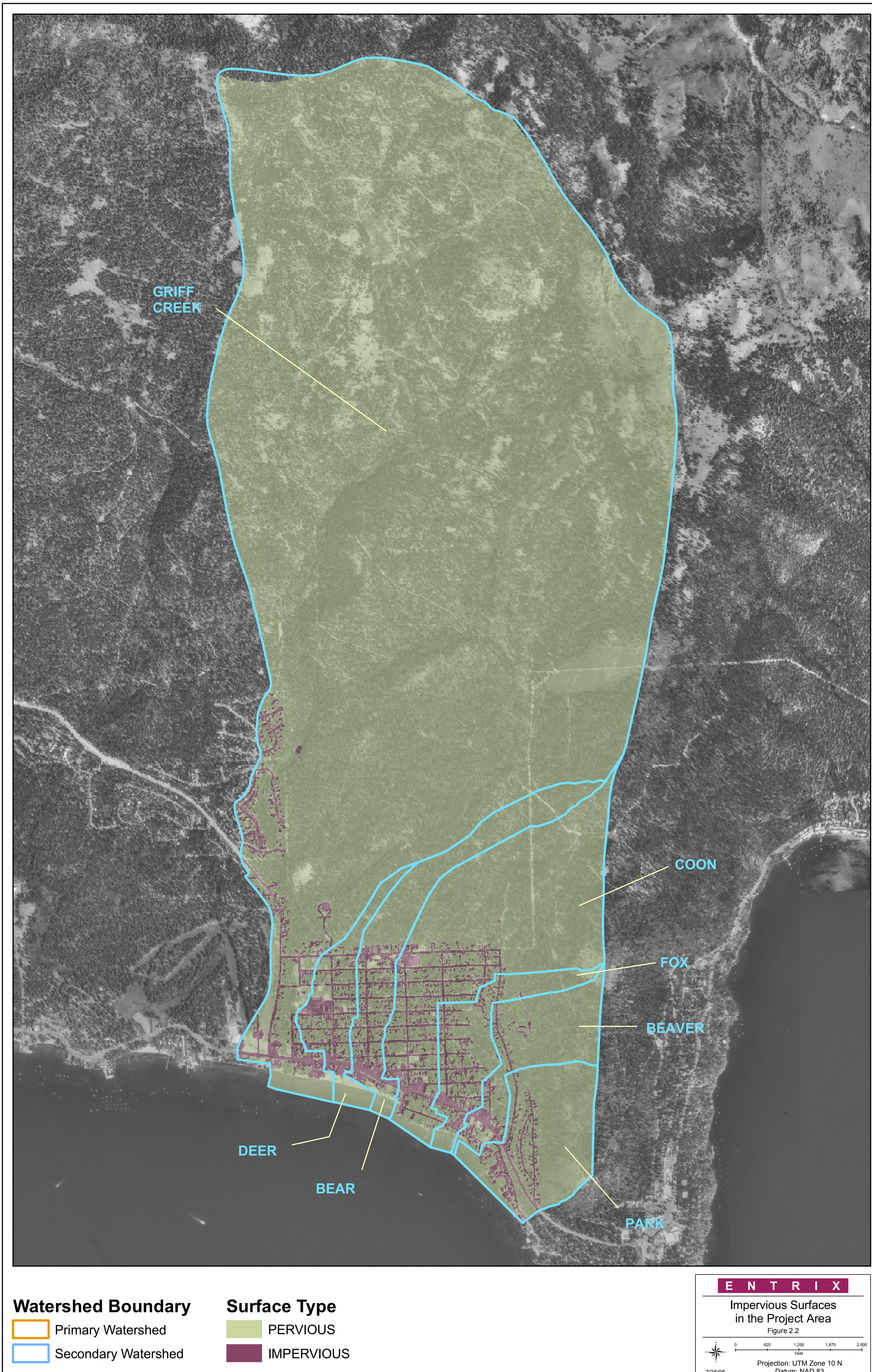
2.2.4 Infiltration Rate

The Placer County drainage manual identifies infiltration rates for the four hydrologic types under different land use conditions. The average infiltrate rate (loss rate) is a key component of the hydrologic model. The loss rate was estimated using the drainage manual and soil map, along with observations of land use. The loss rate for the pervious surfaces, exclusive of the beach areas, is shown in Table 2.4. The beach areas have a high loss rate, however they were not included since they represent only a small portion of the watershed.

Table 2.4. Constant Infiltration Rates (in/hr).

Drainage Basin	Griff	Deer	Bear	Coon	Fox	Beaver	Park
Pervious Areas							
Minimum	0.09	0.12	0.12	0.12	0.12	0.12	0.09
Maximum	0.26	0.24	0.24	0.24	0.24	0.24	0.14
Impervious Areas							
Minimum	0.02	0.03	0.03	0.03	0.03	0.03	0.03
Maximum	0.06	0.03	0.03	0.03	0.03	0.03	0.03
Weighted Infiltration (in/hr)	0.16	0.11	0.16	0.12	0.11	0.12	0.13

Source: Placer County 1990.



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2.2.5 IMPERVIOUS CONNECTIVITY

The spreadsheet model uses four parameters that relate the connectivity of impervious private land and impervious ROW to the drainage basin conveyance facilities (see Table 2.5). The parameters include private land and public ROW that is directly connected to the drainage basin outlet (DCIP and DCIR) and that which are indirectly connected (ICIP and ICIR). Streets, for example, are directly connected (DCIR). Impervious features such as building rooftops, are indirectly connected (ICIP). All four types are represented in the drainage basins (see Table 2.6).

The hydrologic spreadsheet also includes parameters k1 and k2 that relate to the portion of indirectly connected land that actually flows to pervious land. The values of the six parameters are provided in Table 2.6. The parameters were estimated for the seven drainage basins by evaluating the types and density of facilities present. The connectivity parameters were based on a field assessment of the connected features in the drainage basins and the impervious area described in Section 2.2.3. The parameters k1 and k2 were also developed from field observations.

Table 2.5. Definition of the Connectivity Parameters.

Connectivity Parameter	Application to WIP Area
ICIP	Acres of private land indirectly connected to basin outlet, such as homes and businesses that drain to open space/back yards.
ICIR	Acres of ROW indirectly connected to basin outlet such as road shoulders.
DCIP	Acres of private land directly connected to basin outlet such as driveways and parking lots that drain to public drainage facilities.
DCIR	Acres of ROW directly connected to basin outlet, such as roads, storm drains, curb and gutter.
k1	Portion of ICIP that never flows to the basin outlet, such as roof top drainage that is trapped in landscaping. The remainder arrives at the basin outlet.
k2	Portion of ICIR that never flows to the basin outlet, such as level ROW areas where the runoff ponds and infiltrates or evaporates.

Table 2.6. Connectivity Parameters for the Hydrologic Model.

Drainage Basin	Griff	Deer	Bear	Coon	Fox	Beaver	Park
Model Connectivity (acres)[1]							
ICIP	18.37	10.58	13.42	21.25	8.09	6.57	4.47
ICIR	2.04	1.06	0.56	0.97	0.90	0.27	0.37
DCIP	2.04	1.06	0.56	0.97	0.90	0.27	0.37
DCIR	18.37	8.46	7.83	15.46	8.09	3.81	9.68
Loss Rate (in/hr)[2]	0.16	0.11	0.16	0.12	0.11	0.12	0.13
k1[3]	0.30	0.30	0.30	0.30	0.30	0.30	0.30
k2[3]	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Note: 1 – Measured from GIS database,
2 – See Table 2.4. Source: Placer County 1990
3 – Estimated from field observations.
k1 – portion of ICIP flowing to pervious land
k2 – portion of ICIR flowing to pervious land

2.3 MODEL RESULTS

The spreadsheet model was run for each of the seven drainage basins using a mean annual precipitation of 26 inches (Oregon State University 2002). This rainfall depth reflects an average condition for the urbanized basins that accounts for the variation in rainfall depth with elevation across each basin. The results were then applied to the water quality spreadsheet described in Section 2.4. The model output includes a time series of runoff volume under a rainfall pattern measured during the period 1997 through 2002 and exceedance probability for the rainfall depth.

The statistical results of the hydrology model are summarized below.

Mean Annual Precipitation	=	26 inches[1]
Average Event Volume	=	0.29 inches
Average Event Duration	=	6.08 hours
Average Inter-Event Duration	=	74.25 hours
Average Number of Events per Year	=	74.2

(1 - Source: Oregon State University 2002, Brockway Project, Figure 4.4)

	Exceedance Probability		
	5%	**10%**	**50%**
Intensity, in/hr	0.26	0.18	0.09
Volume, in	1.24	0.81	0.18

2.3.1 AVERAGE ANNUAL FLOW RATE

Average annual flow rates as determined by the SWQIC hydrology spreadsheet model are graphically shown in Appendix A.

2.4 POLLUTANT LOADING

The results of the hydrologic model were used in the pollutant loading spreadsheet model, swqic_waterqual.xls (SWQIC 2004). The model uses the runoff volume time series developed from the hydrologic model and four land use types/characteristics of the drainage basins: single family, multi-family, commercial and vacant. The characterization of land use for this analysis is an average for the drainage basin and was conducted through site visits and analysis of GIS data (Table 2.7). Each of the seven drainage basins has an upstream basin that originates in the adjacent forestland. These upslope basins are primarily open space. Commercial land is concentrated at a corridor that runs along the highway. Single family and multi-family are dispersed throughout the residential area, with numerous undeveloped lots within the residential area as well.

The model computes pollutant loads based on typical concentrations of five pollutants of concern. The typical concentrations are applied to the hydrologic time series and the percent of each land use in the drainage basin. The model uses either an average pollutant concentration for each land use or a flow-based concentration based on high, medium and low flow events. The flow-based concentration was used for this analysis.

Table 2.7. Percent of Each Land Use Designation used in the Water Quality Model.

	Percent of Total Area						
Land Use	**Griff**	**Deer**	**Bear**	**Coon**	**Fox**	**Beaver**	**Park**
Commercial	0.61	2.37	4.18	3.81	6.78	4.73	0.16
Multi-family	0.06	6.71	2.80	1.13	4.45	0.32	14.08
Single Family	3.39	78.24	28.05	24.94	67.62	49.86	19.24
Vacant	95.94	12.67	64.97	70.12	21.15	45.09	66.68

The model estimated the pollutant loading for the assumed hydrologic and land use conditions in the seven drainage basins (Table 2.8). Table 2.8 includes the watershed area to show the relationship between pollutant loading and area.

Table 2.8. Results of the Water Quality Loading Analysis.

	Pollutant Load (tons/year)						
Water Quality Parameter	**Griff**	**Deer**	**Bear**	**Coon**	**Fox**	**Beaver**	**Park**
NO3	0.006	0.002	0.002	0.006	0.003	0.002	0.003
TKN	0.155	0.017	0.018	0.051	0.022	0.016	0.021
SRP	0.020	0.002	0.002	0.007	0.002	0.002	0.003
TP	0.052	0.011	0.009	0.027	0.014	0.010	0.010
TSS	6.889	3.804	2.733	7.666	4.670	3.006	3.136
Watershed Area (acres)	2815.29	61.09	133.15	355.79	82.61	94.10	125.29
TSS Loading (lbs/acre)	4.9	124.5	41.1	43.1	113.1	63.9	50.1

Source: SWQIC 2004.

3.1 METHODOLOGY

Runoff from the Kings Beach and Griff Creek watersheds was estimated using the Hydrologic Engineering Center-Hydrologic Modeling System 2.2.2 (HEC-HMS). Model input data was collected from field measurements, site evaluations, ground cover investigations, GIS computer analysis of sub-basin areas, percent impervious cover and surface elevations, along with professional knowledge about the area and the modeling systems. The goal of modeling at this stage is to assess the existing runoff conditions for water quality improvements, therefore a worst case or rain on snow event was not incorporated into the model input at this time. As the project moves forward to alternatives evaluation and design, flood conveyance will be addressed. At that time, the model will be run again with impervious snow-covered rain on snow events, as required in the Placer County Storm Water Management Manual (SWMM). In addition, an effort to calibrate the model using rainfall and runoff data available from the Tahoe Research Group studies on the Coon and Fox Street basins will also be made during alternatives evaluation.

A schematic model of the two watersheds that includes each drainage basin, additional sub-basins, routing reaches that convey water to the lower reaches of the watershed and several reservoirs within each sub-basin that store water throughout the watershed was created in HEC-HMS (Figure 3.1).

3.2 SUB-BASIN WATERSHEDS FURTHER DIVIDED FOR MODELING

To create a model that reflects the various elevations, land uses, flow patterns and concentration points, the two major watersheds were divided into seven sub-basins (Griff, Deer, Bear, Fox, Beaver, Park and Cutthroat/Coon). Upon further investigation of the complexity of the drainage basins, smaller basins were identified. Table 3.1 lists the sub-basins, including abbreviations used in the HEC-HMS model, and the basin designation for the rainfall patterns (Figure 3.2).

3.3 MODEL PARAMETERS

The inputs for each sub-basin included several options for describing the flow paths for rainfall, infiltration and runoff. A description of the parameters and methodologies used for the sub-basins is described below.

3.3.1 INFILTRATION RATE

The conversion of rainfall to excess precipitation was simulated using the initial/constant loss rate for each sub-basin as described in Section 2.2. The constant loss rates were estimated from data presented in the Lake Tahoe Basin Soil Survey, Placer County Drainage Manual and site investigations. The soil survey (Figure 2.1) identifies the Hydrologic Soil types used to estimate the infiltration rate. Table 3.2 lists the infiltration rates used in the model.

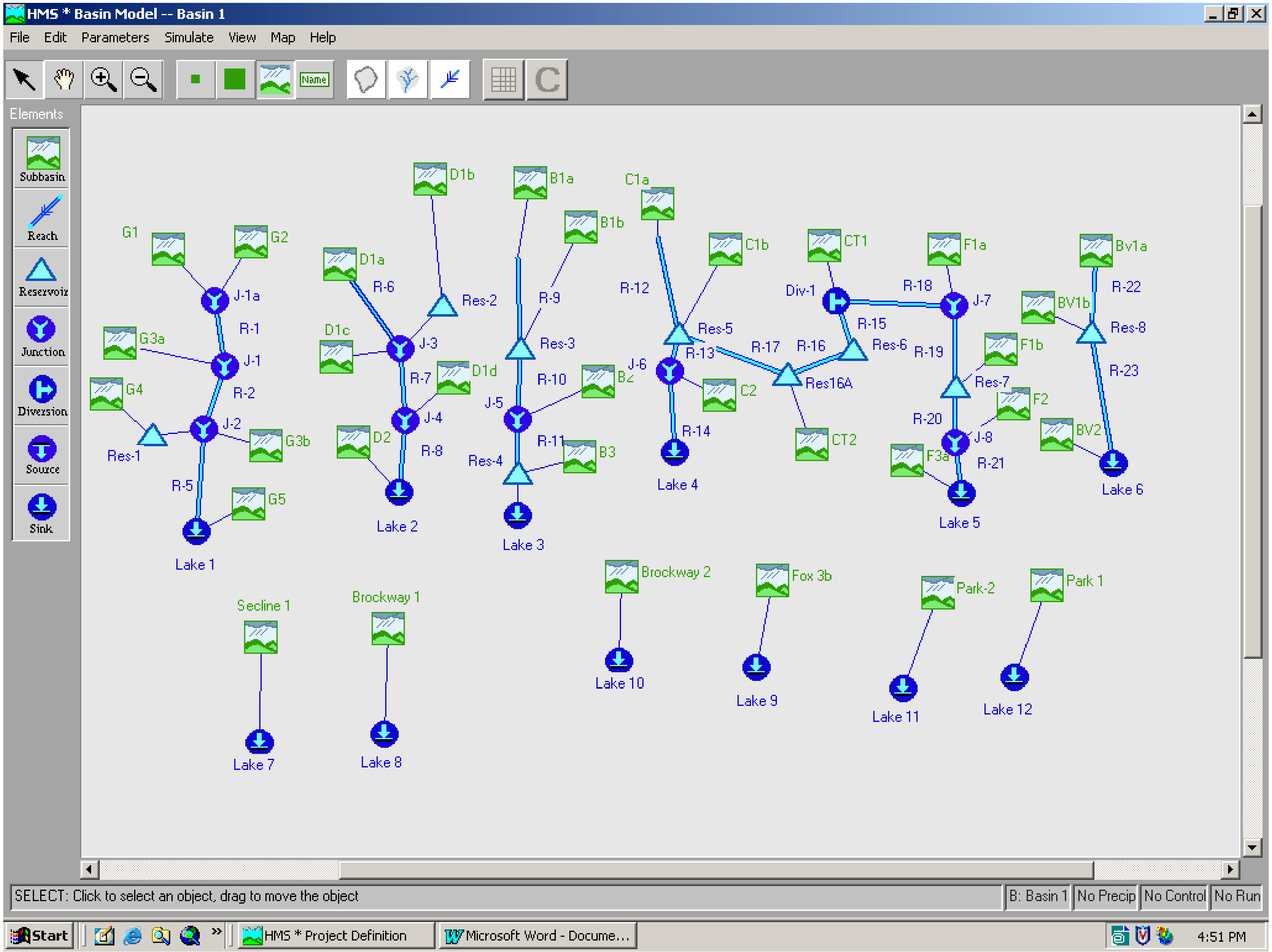
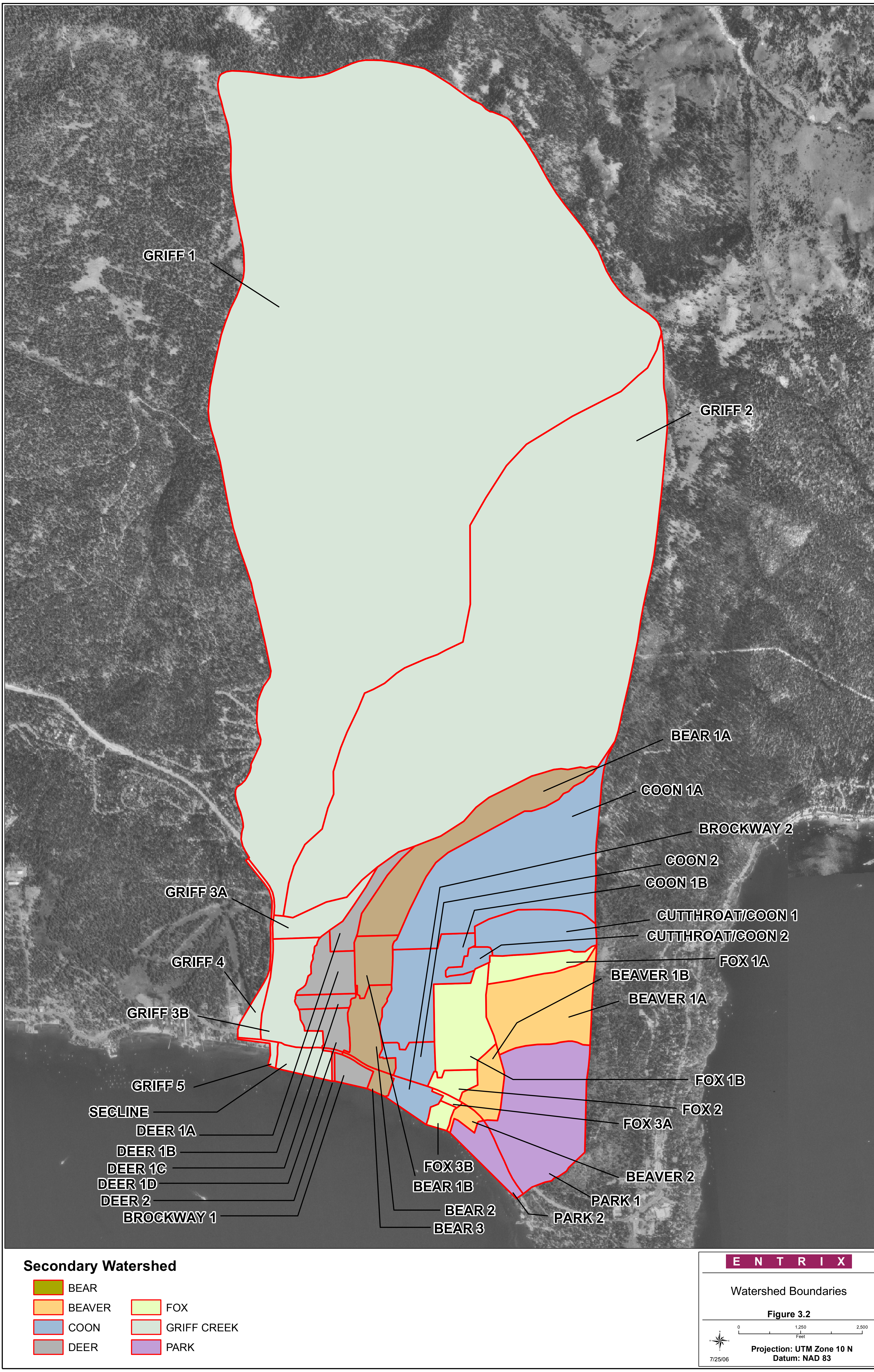


Figure 3.1. HEC-HMS Schematic Model of the Watershed.

The Placer County SWMM requires that a snow-covered condition be assumed when determining the loss rates. Such a condition results in zero initial infiltration loss and a low (or zero) constant loss rate. The scope of work for this analysis, however, requested that the modeling assume spring/summer conditions and not a snow-covered "worst-case" scenario. Therefore, the infiltration parameters used in the model reflect the soils in the watershed and the infiltration characteristics. Prior to design of any conveyance facilities, the model will be run for a snow-covered condition to estimate the effects of snow on the facilities.

Table 3.1. HEC-HMS Model Sub-Basins.

Sub-Basin Name	Abbreviation	Watershed Designation	Area (acres)	Sub-Basin Name	Abbreviation	Watershed Designation	Area (acres)
Griff Creek				**Cutthroat/Coon**			
Griff 1	G1	Upper	1,887	Cutthroat/ Coon 1	CT1	Middle	43.8
Griff 2	G2	Upper	837.6	Cutthroat/ Coon 2	CT2	Middle	6.5
Griff 3a	G3a	Middle	21.2	**Beaver Street**			
Griff 3b	G3b	Middle	41.6	Beaver 1a	BV1a	Middle	70.9
Griff 4	G4	Middle	11.4	Beaver 1b	BV1b	Lower	18.3
Griff 5	G5	Lower	2.4	Beaver 2	BV2	Lower	4.9
Deer Street				**Fox Street**			
Deer 1a	D1a	Middle	16.4	Fox 1a	F1a	Middle	20.1
Deer 1b	D1b	Middle	21.1	Fox 1b	F1b	Middle	46.1
Deer 1c	D1c	Middle	7.6	Fox 2	F2	Lower	9.3
Deer 1d	D1d	Lower	14.7	Fox 3a	F3a	Lower	1.8
Deer 2	D2	Lower	1.3				
Bear Street				**Lakefront Basins**			
Bear 1a	B1a	Middle	75.0	Secline 1	Secline 1	Lower	14.3
Bear 1b	B1b	Middle	18.9	Brockway 1	Brockway 1	Lower	8.4
Bear 2	B2	Middle	25.4	Brockway 2	Brockway 2	Lower	13.5
Bear 3	B3	Lower	5.5	Fox 3b	Fox 3b	Lower	5.2
Coon Street				**Park Street**			
Coon 1a	C1a	Middle	176.0	Park 1	Park 1	Upper	107.7
Coon 1b	C1b	Middle	56.3	Park 2	Park 2	Lower	17.6
Coon 2	C2	Lower	15.9				



Watershed Boundaries

Figure 3.2

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Table 3.2. Infiltration Rates for the Model Sub-basins.

Sub-Basin	Initial Loss Rate (in)	Constant Loss Rate (in/hr)		
		Minimum	Maximum	Average
Griff Creek				
G1	0.1	0.09	0.44	0.17
G2	0.1	0.11	0.53	0.19
G3a	0.1	0.09	0.47	0.15
G3b	0.1	0.06	0.27	0.08
G4	0.1	0.12	0.48	0.17
G5	0.1	0.06	0.24	0.22
Deer Street				
D1a	0.1	0.09	0.47	0.18
D1b	0.1	0.06	0.27	0.09
D1c	0.1	0.07	0.31	0.09
D1d	0.1	0.06	0.24	0.07
D2	0.1	0.06	0.24	0.23
Bear Street				
B1a	0.1	0.11	0.53	0.18
B1b	0.1	0.06	0.27	0.11
B2	0.1	0.06	0.24	0.09
B3	0.1	0.06	0.24	0.24
Coon Street				
C1a	0.1	0.11	0.53	0.15
C1b	0.1	0.06	0.27	0.09
C2	0.1	0.06	0.24	0.08
CT1	0.1	0.09	0.47	0.13
CT2	0.1	0.06	0.27	0.09
Fox Street				
F1a	0.1	0.09	0.47	0.14
F1b	0.1	0.06	0.27	0.09
F2	0.1	0.07	0.31	0.09
F3a	0.1	0.06	0.24	0.08

Table 3.2. Infiltration Rates for the Model Sub-basins (continued).

Sub-Basin	Initial Loss Rate (in)	Constant Loss Rate (in/hr)		
		Minimum	Maximum	Average
Beaver Street				
BV1a	0.1	0.09	0.47	0.13
BV1b	0.1	0.06	0.27	0.09
BV2	0.1	0.06	0.24	0.14
Lakefront Basins				
Secline 1	0.1	0.06	0.24	0.24
Brockway 1	0.1	0.06	0.24	0.24
Brockway 2	0.1	0.06	0.24	0.15
Fox 3b	0.1	0.06	0.24	0.2
Park Street				
Park 1	0.1	0.09	0.47	0.12
Park 2	0.1	0.06	0.24	0.16

Source: Soil Conservation Service, 1974.

3.3.2 Flow Routing

Two methods for routing runoff across the land surface and in channels were used, SCS lag and Kinematic wave. SCS lag was used in sub-basins with well-defined channels, and Kinematic wave was used where runoff was dominated by sheet flow, such as urbanized areas where streets and ditches collected and redirected flow.

Input for computing the SCS lag included slope, hydraulic length of the sub-basin and estimated runoff Curve Numbers (CN) which account for soil type and ground cover. The slope and length of the sub-basin were estimated from the topographic maps generated in GIS. The parameters used in the routing calculations are listed in Table 3.3.

The equation for computing lag time was found in McCuen (1982):

$$L = \frac{l^{0.8}(S+1)^{0.7}}{1900Y^{0.5}}$$

where:

L =lag (hours)

l= hydraulic length (feet)

S= basin storage

Y= slope (percent)

Lag time represents the time from the center of excess rainfall to the peak discharge. Basin storage is defined as:

$$S = \frac{1000}{CN} - 10$$

where CN is estimated from a table using known SCS soil classes within the sub-basin and dominant ground cover type observed in the field (McCuen 1982).

Kinematic wave also utilized the same parameters as the SCS lag routing method, with additional information pertaining to the length and slope of each flow plane and the type of drainage culvert. Roughness coefficients (Manning's n) for the flow paths were also estimated using Table 5.5 in the Placer County Stormwater Management Manual. Computations for the Kinematic wave procedure were performed in HEC-HMS.

Routing reaches were also used when upper sub-basin flow was diverted into a storm drain and emptied further down in the watershed. The lengths of the routing reach, slope of the reach and roughness coefficient (Manning's n) were also input to the model parameters. The same procedure for calculating lag time was used to calculate the lag time for the routing reaches.

Several reservoirs and one diversion are also present in the watershed and are used for storage of rainfall and runoff produced in the sub-basins. The volume of each reservoir was calculated from existing site plans, and the outflow discharge was calculated from field measurements of outflow pipes.

3.3.3 Rainfall Patterns

Four storm events were used within the model to generate rainfall patterns and associated discharge. The storm events simulated included:

- 2-year/1-hour
- 2-year/72-hour
- 25-year/1-hour
- 25-year/72-hour

Methods used to calculate rainfall patterns are described in the SWMM, Appendix V-B: Storm Design Procedures. The manual provides rainfall depth data for several storm duration and return periods for two elevations that bracket the elevations in the WIP area (6000 E and 7000 W). Because the Kings Beach and Griff Creek watersheds range in elevation from 6,230 at the lake to over 8,000 at Martis Peak, the sub-basins were classified as upper, middle and lower. (The upper, middle and lower designations for each sub-basin are identified in Table 3.1). Rainfall depths for the upper basins were calculated from the data provided for the 7000 W elevation. Rainfall depths for the middle elevations (average 6,500 feet) were averaged from the 6000 E and 7000 W rainfall depths. Rainfall depths for the lower elevations (average 6,250 feet) were averaged from the 6,500 feet and 6,000 feet depth calculations.

Table 3.3. Model Parameters used for Estimating Hydrograph Transform.

		SCS Lag		Kinematic Wave								
				Flow Plane			Collector Channel			Main Channel		
	Method	CN[1]	SCS Lag (min)	Length	Slope	Roughness	Length	Slope	Roughness	Length	Slope	Roughness
Griff												
G1	SCS	60	90	--	--	--	--	--	--	--	--	--
G2	SCS	60	60	--	--	--	--	--	--	--	--	--
G3a	SCS	70	15.0	--	--	--	--	--	--	--	--	--
G3b	KW	--	--	240	.021	.15	1005	0.008	.04	2040	.021	.06
G4	SCS	70	7.0	--	--	--	--	--	--	--	--	--
G5	KW	--	--	144	.11	.13	--	--	--	420	.04	.02
Deer												
D1a	SCS	65	20.4	--	--	--	--	--	--	--	--	--
D1b	KW	--	--	240	.07	.15	984	.05	.045	975	.07	.05
D1c	KW	--	--	288	.03	.15	--	--	--	1020	.01	.012
D1d	KW	--	--	240	.015	.15	750	.003	.04	504	015	.04
D2	SCS	98	4.0	--	--	--	--	--	--	--	--	--
Bear												
B1a	SCS	70	27.6	--	--	--	--	--	--	--	--	--
B1b	KW	--	--	240	.07	0.15	750	.02	0.1	870	0.07	.012
B2	KW	--	--	240	.033	0.15	600	.02	.15	1620	.033	.012
B3	SCS	98	3	--	--	--	--	--	--	--	--	--

Table 3.3. Model Parameters used for Estimating Hydrograph Transform (continued).

	Method	SCS Lag		Kinematic Wave								
				Flow Plane			Collector Channel			Main Channel		
	Method	CN[1]	SCS Lag (min)	Length	Slope	Roughness	Length	Slope	Roughness	Length	Slope	Roughness
Coon												
C1a	SCS	75	20.4	--	--	--	--	--	--	--	--	--
C1b	KW	--	--	240	.07	.18	1215	.03	.045	1740	.07	.012
C2	KW	--	--	240	.04	.15	966	.015	.045	864	.04	.012
CT1	SCS	60	12.0	--	--	--	--	--	--	--	--	--
CT2	KW	--	--	360	.15	.15	--	--	--	900	.014	.045
Fox												
F1a	SCS	70	8.0	--	--	--	--	--	--	--	--	--
F1b	KW	--	--	240	.08	.15	1056	.24	.045	1740	.11	.012
F2	KW	--	--	240	.008	.15	960	.11	.045	552	.017	.012
F3a	KW	--	--	360	.06	.15	--	--	--	360	.02	.045
Beaver												
BV1a	SCS	70	12.0	--	--	--	--	--	--	--	--	--
BV1b	KW	--	--	666	.30	.15	--	--	--	1392	.15	.045
BV2	KW	--	--	360	.05	.15	--	--	--	540	.10	.045
Lakefront Basins												
Secline 1	SCS	98	4.0	--	--	--	--	--	--	--	--	--
Brockway 1	SCS	98	4.0	--	--	--	--	--	--	--	--	--

Table 3.3. Model Parameters used for Estimating Hydrograph Transform (continued).

		SCS Lag		Kinematic Wave								
				Flow Plane			Collector Channel			Main Channel		
	Method	CN[1]	SCS Lag (min)	Length	Slope	Roughness	Length	Slope	Roughness	Length	Slope	Roughness
Brockway 2	SCS	98	5.2	--	--	--	--	--	--	--	--	--
Fox 3b	SCS	98	3.0	--	--	--	--	--	--	--	--	--
Park												
Park 1	SCS	98	3.0	--	--	--	--	--	--	--	--	--
Park-2	SCS	98	4.0	--	--	--	--	--	--	--	--	--

1 – CN = Curve Number

Baseflow was assumed for the subbasins based on the snowmelt rates described in the SWMM, Table 5-2. The rate was equal to the tabulated rate, in inches/hour, multiplied by the watershed area and converted to cubic feet per second (cfs). A multiplier was applied to the results to reflect the fact that not all snowmelt reaches the watershed outlet. The multiplier was estimated based on comparing a measured streamflow of Griff Creek taken in June 2005 and the baseflow from the SWMM. The multiplier was estimated to be 0.252.

3.4 Flow Duration Curves of 2-year and 25-year Events for Sub-basin Watersheds

Different rainfall patterns were generated for simulated storm events following procedures outlined in the SWMM, Appendix V-B: Storm Design Procedures. Both storm events were run on a 5-minute time step. Rainfall depths for storm events were calculated using Table 5-A-2 provided in Appendix A of the SWMM. When specific depths were not provided in the table, depths were extrapolated using a log-log interpolation equation also provided in the manual:

$$d = d_1\left(\frac{t}{t_1}\right)^k$$

where:

d= depth (inches)

t= duration (minutes)

and

$$k = \frac{\log\left(\frac{d_2}{d_1}\right)}{\log\left(\frac{t_1}{t_1}\right)}$$

A rainfall pattern was generated using the calculated incremental rainfall depths for each storm event. To generate the rainfall pattern, the largest depth was placed in the center of the duration period and alternating after and before the maximum depth in descending order. The rainfall pattern was assumed to be uniform across each basin.

3.5 Storm Event Volumes for Selected Rainfall Events

The HEC-HMS model output data calculates the total volume (acre/feet) for each sub-basin, reservoir, junction, routing reach and total output to the lake. The total volume of water for each sub-basin and junction within the watershed is summarized in Table 3.4.

Table 3.4. Total Runoff Volume for Simulated Storms.

Sub-Basin[1]	2-Year / 1-Hour	2-Year / 72-Hour	25-Year / 1-Hour	25 Year / 72-Hour
Griff Creek				
G1	0.7	344.8	1.4	1193.6
G2	0.1	150.8	0.1	526.9
J-1a	0.7	495.6	1.5	1720.5
G3a	0.1	5.2	0.2	14.1
J-1	0.8	500.8	1.7	1734.6
G3b	1.1	9.1	2.5	26.7
J-2	1.9	513.2	4.3	1769.9
G4	0.1	3.4	0.2	8.7
G5	0.0	0.2	0.1	0.5
Griff Outlet	2.0	513.4	4.4	1770.4
Deer				
D1a	0.1	3.8	0.1	11.2
D1b	0.5	4.7	1.2	12.6
D1c	0.2	1.5	0.4	4.1
J-3	0.7	10.0	1.6	27.8
D1d	0.3	3.6	0.7	8.0
J-4	1.0	13.6	2.3	35.8
D2	0.0	0.2	0.1	0.4
Deer Outlet	1.0	13.8	2.4	36.2
Bear				
B1a	0.1	15.9	0.1	46.4
B1b	0.5	4.1	1.1	10.3
B2	0.7	6.5	1.5	16.3
J-5	0.9	26.2	2.4	72.7
B3	0.1	0.3	0.2	0.8
Bear Outlet	0.5	26.0	2.1	73.0
Coon				
C1a	0.2	42.5	0.4	114.4
C1b	1.4	10.7	3.2	31.3
C2	0.3	3.3	0.7	7.8
J-6	1.0	62.7	3.6	171.8
CT1	0.1	6.7	0.1	22.4
CT2	0.1	1.0	0.3	3.2
Coon Outlet	1.0	62.7	3.6	171.8

1 – Outlet refers to the total watershed contributing to Lake Tahoe. For example, Griff Outlet is the contribution of the entire Griff Creek watershed to the lake.

Table 3.4. Total Runoff Volume for Simulated Storms (continued).

Sub-Basin[1]	2-Year / 1-Hour	2-Year / 72-Hour	25-Year / 1-Hour	25 Year / 72-Hour
Fox				
F1a	0.04	4.3	0.1	12.2
J-7	0.04	4.3	0.1	12.2
F1b	1.0	7.5	2.5	23.2
F2	0.2	1.6	0.3	3.7
J-8	0.9	13.0	2.5	38.8
F3a	0.0	0.5	0.1	1.1
Fox Outlet	0.9	13.5	2.6	39.9
Beaver				
BV1a	0.1	15.0	0.2	43.0
BV1b	0.4	3.6	1.0	9.4
BV2	0.1	0.9	0.3	2.3
Beaver Outlet	0.4	19.2	1.2	54.4
Lakefront Basins				
Secline 1 Outlet	0.1	4.4	0.2	9.5
Brockway 1 Outlet	0.0	2.1	0.1	4.7
Brockway 2 Outlet	0.1	4.4	0.3	9.6
Fox 3b Outlet	0.0	1.7	0.1	3.8
Park				
Park 1 Outlet	0.7	48.0	3.0	108.8
Park 2 Outlet	0.2	6.8	0.5	14.5

1 – Outlet refers to the total watershed contributing to Lake Tahoe. For example, Griff Outlet is the contribution of the entire Griff Creek watershed to the lake.

3.6 PEAK FLOWS FOR SELECTED RAINFALL EVENTS

The HEC-HMS model output calculates peak flows for each sub-basin, reservoir, junction and routing reach in the watershed. The output also lists the time at which each parameter reaches peak flow. Table 3.5 is a summary of each sub-basin and junction with the corresponding peak flow and time of peak for the different storm events. As a note, the time of peak is recorded as the number of minutes after the initiation of the storm event.

Results of the rainfall simulation indicate that a 25-year/72-hour storm event yields the largest discharge from the Griff Creek watershed (1,381 cfs – Lake 1), followed by the 25-year/1-hour storm (938 cfs – Lake 1). The 2-year storm events yielded similar total discharges (342 and 456 cfs) for the 1-hour and 72-hour storms, respectively (see Table 3.5).

Output data indicate that the lag time for the larger sub-basins in the upper reaches of the watershed, such as Griff 1 and Griff 2, do not entirely contribute to the discharge during the 2-year/1-hour storm event. The peak of the storm has passed before the water in the upper reaches of the sub-basin is collected in the lower basins.

Table 3.5. Peak Discharge for the Simulated Storms.

Sub-Basin[1]	2-Year / 1-Hour Peak Flow (cfs)	2-Year / 1-Hour Time to Peak (min)	2-Year / 72-Hour Peak Flow (cfs)	2-Year / 72-Hour Time to Peak (min)	25-Year / 1-Hour Peak Flow (cfs)	25-Year / 1-Hour Time to Peak (min)	25 Year / 72-Hour Peak Flow (cfs)	25 Year / 72-Hour Time to Peak (min)
Griff Creek								
G1	3.9	122	219.8	800	7.9	122	805.8	795
G2	0.4	92	110.1	765	0.9	92	406.0	760
J-1a	4.2	118	320.0	790	8.5	118	1177.2	780
G3a	1.5	44	5.1	720	2.9	44	13.9	720
J-1	4.2	120	322.4	790	8.6	120	1184.0	785
G3b	15.9	58	15.5	720	45.3	46	33.0	715
G4	18.3	64	329.1	805	52.7	46	1199.8	800
J-2	2.3	34	3.4	720	4.6	36	8.5	720
G5	1.0	34	0.5	715	3.1	32	1.4	715
Griff Outlet	18.4	68	329.1	810	53.8	50	1199.6	805
Deer								
D1a	1.0	50	3.6	725	2.1	50	10.9	725
D1b	11.7	36	7.4	715	29.3	34	15.6	715
D1c	3.1	42	2.4	715	8.4	36	5.2	715
J-3	16.7	36	13.4	720	47.8	36	31.5	720
D1d	4.6	56	4.7	720	11.9	44	8.9	715
J-4	20.1	46	18.0	720	59.5	42	40.3	720
D2	0.7	32	0.3	690	1.7	32	0.7	690
Deer Outlet	18.8	48	18.3	720	50.4	44	41.0	720
Bear								
B1a	0.7	58	15.2	730	1.3	60	44.2	730
B1b	7.0	54	6.4	715	19.7	44	13.9	715
B2	10.8	46	9.1	715	29.1	40	19.0	715
J-5	10.8	46	29.9	725	42.0	50	74.8	720
B3	3.3	30	1.0	685	8.5	32	3.3	685
Bear Outlet	13.2	78	30.0	720	48.0	54	76.8	720
Coon								
C1a	2.5	50	42.8	725	5.0	52	111.9	720
C1b	20.9	54	19.5	715	60.1	42	41.9	715
C2	5.5	44	4.4	715	13.9	38	8.9	715
J-6	27.4	92	69.5	750	125.4	68	169.5	745
CT1	1.2	40	6.4	720	2.4	42	22.8	720
CT2	2.3	50	2.1	715	6.8	40	4.6	715
Coon Outlet	27.4	92	69.5	750	125.4	68	169.5	745

1 – Outlet refers to the total watershed contributing to Lake Tahoe. For example, Griff Outlet is the contribution of the entire Griff Creek watershed to the lake.

Table 3.5. Peak Discharge for the Simulated Storms (continued).

Sub-Basin[1]	2-Year / 1-Hour Peak Flow (cfs)	2-Year / 1-Hour Time to Peak (min)	2-Year / 72-Hour Peak Flow (cfs)	2-Year / 72-Hour Time to Peak (min)	25-Year / 1-Hour Peak Flow (cfs)	25-Year / 1-Hour Time to Peak (min)	25 Year / 72-Hour Peak Flow (cfs)	25 Year / 72-Hour Time to Peak (min)
Fox								
F1a	0.8	36	4.5	720	1.6	36	12.4	720
J-7	0.8	36	4.5	720	1.6	36	12.4	720
F1b	20.5	40	15.0	715	56.2	36	32.4	715
F2	2.0	62	2.1	720	5.3	48	4.4	715
J-8	20.7	48	21.5	720	60.6	38	49.1	715
F3a	0.6	60	0.6	720	1.6	46	1.3	715
Fox Outlet	21.2	54	22.1	725	62.2	44	50.4	720
Beaver								
BV1a	1.7	40	15.4	720	3.4	42	43.6	720
BV1b	6.1	56	6.1	715	16.8	42	13.0	715
BV2	1.9	50	1.8	715	5.8	40	4.1	715
Beaver Outlet	10.8	64	22.9	720	28.7	44	60.1	720
Lakefront Basins								
Secline 1 Outlet	1.0	60	4.4	720	5.2	34	9.1	720
Brockway 1 Outlet	0.4	60	2.2	720	2.1	36	4.5	720
Brockway 2 Outlet	1.4	32	4.4	720	5.7	36	9.1	720
Fox 3b Outlet	0.4	30	1.8	720	2.2	32	3.6	720
Park								
Park 1	13.5	60	46.2	720	74.7	32	96.9	720
Park 2	3.2	32	6.7	720	10.5	34	13.7	720

1 – Outlet refers to the total watershed contributing to Lake Tahoe. For example, Griff Outlet is the contribution of the entire Griff Creek watershed to the lake.

4.0
DETAILED DRAINAGE CONVEYANCE MAP

A watershed area map was provided under a previous contract (Harding ESE 2002). This map was reviewed and revised based on field examination of existing drainage facilities, flow patterns and topography. Drainage and sub-area boundaries and existing drainage infrastructure were noted on maps in the field. Each block within the residential and commercial area was walked, and the information gathered in the field was subsequently transferred via AutoCAD into a detailed drainage conveyance map (Appendix F).

The general drainage conveyance map was divided into three plan sheets titled, Detailed Drainage Conveyance Map - North, Middle, and South (Appendix F) in order to display the large WIP area more clearly. These three plan sheets depict the two main watersheds, as well as appropriately identified drainage basins and concentration points. The outfall of these concentration points and the stormwater outfalls to Lake Tahoe from the WIP area are identified and labeled. In addition, drainage basins discharging to surface waters are identified and labeled.

Six additional plan sheets, focused on the residential and commercial regions within the WIP area, are provided to highlight drainage features and existing infrastructure. The Residential/Commercial Core – Key Map shows how the plan sheets were laid out, and the detailed drainage information is displayed on Residential/Commercial Core – Sheets 1 through 5 (Appendix F). Various drainage components and more recently constructed erosion control improvements are noted on these maps. The five maps also identify pollution source areas described in more detail in Section 5.0.

5.1 METHODOLOGY

Sediment and nutrient source areas were identified and mapped using the following general methodology.

An initial reconnaissance was conducted to determine the range and types of source areas within the watershed. The residential grid and urban core portions of the WIP area were the focus of this investigation. The upper portions of the watershed are undeveloped lands under public ownership. Sediment and nutrient source areas on these lands have been previously identified (Harding ESE 2002). The largest proportion of undeveloped lands was reported as a minor or potential source of sediment and pollutant loading due mostly to unvegetated road banks, eroding roadway surfaces and unstable waterbars. There were intermittent major sources of pollutants in the undeveloped lands associated with unstable road and trail crossings at creeks, road capture of creek water and steep roads without waterbars.

Residential streets and urban core are two distinct areas with different water quality issues. The residential grid is typical of early Lake Tahoe Basin subdivisions with a poorly developed roadside drainage system. Road shoulder disturbance by automobiles, bicycles and pedestrians is also occurring in this densely populated area and represents a significant observed source category.

The urban core was observed to be a repository for stored fine material and is a presumed deposition area due to the location within the watershed and the flatter slope of the highway alignment and commercial parking areas. Accumulations large enough that they could be removed with a shovel and broom were observed adjacent to drop inlets in many areas. Drop inlet sumps on the downhill (lake) side of State Route 28 also held standing water a number of weeks after any significant precipitation. Traction sand application is presumably higher in these areas, and vehicular crushing of these coarser materials is believed to be a significant process for generating fine sediments. Aerial redistribution due to vehicle wakes is also presumed to occur.

Based on the initial reconnaissance, source area categories and a problem area identification protocol appropriate to the WIP area were developed. Source area categories and corresponding BMP solutions are shown in Tables 5.1 and 5.2. A Field Sheet was developed and used to encourage uniform data collection, a sample of which is contained in Appendix B. Copies of the WIP area base map were marked in the field, and each problem area was assigned an identifier. Field Sheet data included a problem description, location information, and area, slope and condition assessment data for each problem area. Digital photographs of problem areas and other features of the WIP area of hydrologic interest were taken and recorded on a photo log containing a description, vantage point and direction.

Table 5.1. Pollutant Source Categories.

Source Category	Description
Slope, SL:	Slope erosion, rilling or gullying.
Shoulder, S:	Mechanical road shoulder disturbance.
Bank, B:	Bank erosion along an existing ditch or swale.
Channel, C:	Active channel erosion or downcutting.
Stored Sediment, SS:	Sediment deposition subject to remobilization. Proximal source.
Other, O:	Nutrient or sediment source not categorized above or inadequate transport process (inadequate drainage facility).
Potential Problem, PP:	Areas or facilities that could constitute a pollutant source depending on condition or maintenance practices.

Table 5.2. Suggested BMPs by Source Category.

Source Category	Suggested BMP
Slope, SL:	Revegetation, blanketing, mulching, coir logs installed on the contour. In more severe cases, grading back the slope or installing retaining walls.
Shoulder, S:	Revegetation and mulching. Installation of parking barriers. Paving or pervious pavers where appropriate. Provision of curb and gutter where appropriate. Administrative changes such as reevaluating the uniformity of fee parking.
Bank, B:	Revegetation, blanketing, rock – lining.
Channel, C:	Reconstruction using geotextiles an addition to rock lining. Underseeding with erosion control blankets.
Stored Sediment, SS:	Establishment of an effective removal (sweeping?) program that includes commercial parking areas. Regional treatment utilizing long term settling possibly augmented by advanced treatment (chemical coagulants).
Other, O:	Various, as appropriate to the specific problem.
Potential Problem, PP:	Operational and maintenance practices which embrace pollutant control.

Field mapping was conducted in early July 2005 over a several week period by ENTRIX and c2me Engineering staff, either individually or in multiple teams of two. For complete and uniform coverage, field data collection was conducted by drainage basin in a block-wise fashion. Over 300 source areas were categorized, mapped and described on field sheets or in field books. Area measurements were taken using a wheel and tape, and in some cases by pacing. Scaling relatively long linear distances off the base map was also used to tabulate areas for subsequent ranking. Mapped data was compiled onto separate AutoCAD layers on the base map corresponding to problem area type (Appendix F –Residential/Commercial Core-Plan Sheets 1–5). Field sheet data was tabulated in EXCEL (Appendix C).

Source areas were ranked to assist in prioritization using field data for area, slope and condition (Appendix D). The ranking methodology employed was developed with reference to Section A-4.3 of SWQIC and is similar to that used for the Tahoe Estates Erosion Control Project. Higher assigned scores for a given parameter indicate a more severe problem.

Area: Field measured areas for each problem were sorted by size and the values corresponding to the 1/3 and 2/3 points in the data set were identified. These values, 600 square feet and 1,902 square feet, were used as thresholds for dividing the set of areas into thirds. A score of 1 was assigned to the group of areas between 0 and 600 square feet, a score of 2 was assigned to the group of areas between 600 and 1,902 square feet, and a score of 3 was assigned to the group of areas greater than 1,902 square feet.

Slope: Problem area slopes were classified in the field as being 4:1 or flatter, between 2:1 and 4:1 and 2:1 or steeper. A score range of 1 to 3 was assigned for each slope, with flatter slopes receiving a lower score.

Condition: A subjective cover/condition assessment was also made in the field. Assessments of Poor, Medium and Good were assigned a numerical score of 3, 2 or 1, respectively. Notes regarding cover/condition were made in the field to assist in gaining some uniformity among different assessors. In general, bare soil surfaces exhibiting a powdery texture were candidates for a “Poor” assessment, while surfaces with significant mulch or vegetative cover were assessed a “Good” score. A score of “Medium” was assigned to areas that fell between these two conditions.

Risk: A hydrologic risk parameter was also included as a placeholder for future consideration and development. This parameter is intended to represent connectivity by using tributary area as a surrogate. Tributary areas could be tabulated and scored using a methodology similar to that used for the area parameter.

Finally, the scores for the various parameters are summed to compute an overall score. Relative importance or weighting factors are included at the top of the spreadsheet so that if, for instance, the TAC designated area to be twice as important as slope, the spreadsheet could be updated with area having a weight factor of two. The default values presented herein do not yet include weighted factors, therefore all three parameters currently have equal importance.

Ranking the pollutant source areas in the residential areas without using weighting factors results in values from 3 to 7; the higher value representing a greater potential pollutant source.

The urban core is primarily hardscape, and urban core processes were not amenable to the assessment and ranking used for the residential grid. The urban core was walked, and processes (primarily sediment storage) were documented on a Field Sheet and in photo logs. For mapping purposes, the urban core processes were lumped together and represented as strips along either side of the State Route 28 ROW (Appendix F).

Results of the residential grid ranking are somewhat difficult to interpret in that no obvious patterns result from the tabular analysis. Pollutant sources throughout the residential grid area are fairly well distributed, and mostly uniform in severity, as shown on the map. There are no large eroding cut slopes, for example, that serve as “poster problems”. Disturbed earthen shoulders were the most common and numerous source areas were identified while bare eroding slopes and degraded channels were interspersed throughout the WIP area. Some conveyance problems labeled as “other” also had implications to source areas such as improperly placed culverts with rilling at the outlet. Figures 5.1 through 5.4 represent a sampling of the pollutant source areas within the residential portion of the WIP area.

Reports from Placer County from 2000 to 2004 show a range of 66 to 203 tons of traction sand per year applied to County roads within the Kings Beach area. They also report on the level of sediment and nutrients found in the 2003 and 2004 sand samples, with a range of 470-1000 mg/kg of Total Phosphorus, 8.1 to 20 mg/kg of Total Nitrogen and 9200 to 13,333 mg/kg of Iron. The California Department of Transportation (Caltrans) provided reports on traction sand application onto 11 miles of State Route 28 that included the Kings Beach WIP area from 1989 to 2004. For the approximate 1.3 mile section of State Route 28 in the Kings Beach WIP area, the range was roughly 117 tons to 521 tons of sand per year. A Caltrans representative emphasized that their maintenance program collects and hauls sand-laden snow and vacuums sand and sediments from the highway and drainage inlets. Their records show a 92 percent average recovery of sand and sediment from the highway during the last four years.

Field observation of the urban core indicated there are significant deposits of fine material in flat, hardscaped areas. The interstitial “pits” in the pavement surface were also observed to hold material, which in aggregate could represent a significant source volume. Quantification of these volumes could be accomplished and would be quite informative, however that is beyond the scope of this investigation. Particle size analysis could also be conducted on dry material samples and the comments above apply.

Figure 5.1. Accumulation of Road Sand and Cinders at State Route 28.

Figure 5.2. Eroding, Disturbed Earthen Shoulder.

Figure 5.3. Sparsely Vegetated, Eroding Slope.

Figure 5.4. Off-Road Parking Disturbance.

6.0 Coordination and Consultation

The TAC Draft Hydrologic Conditions Report was released in August 2005. Three comment letters were received from the agencies listed below. The comments and associated responses are listed in Appendix E.

Agency	**Author**
Tahoe Regional Planning Agency	Jon-Paul Harries
Caltrans	Sean Penders
Caltrans	Cameron Knudson
California Tahoe Conservancy	Zach Hymanson

7.0
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Appendix A

Graphical Results of the SWQIC Annual Runoff Model

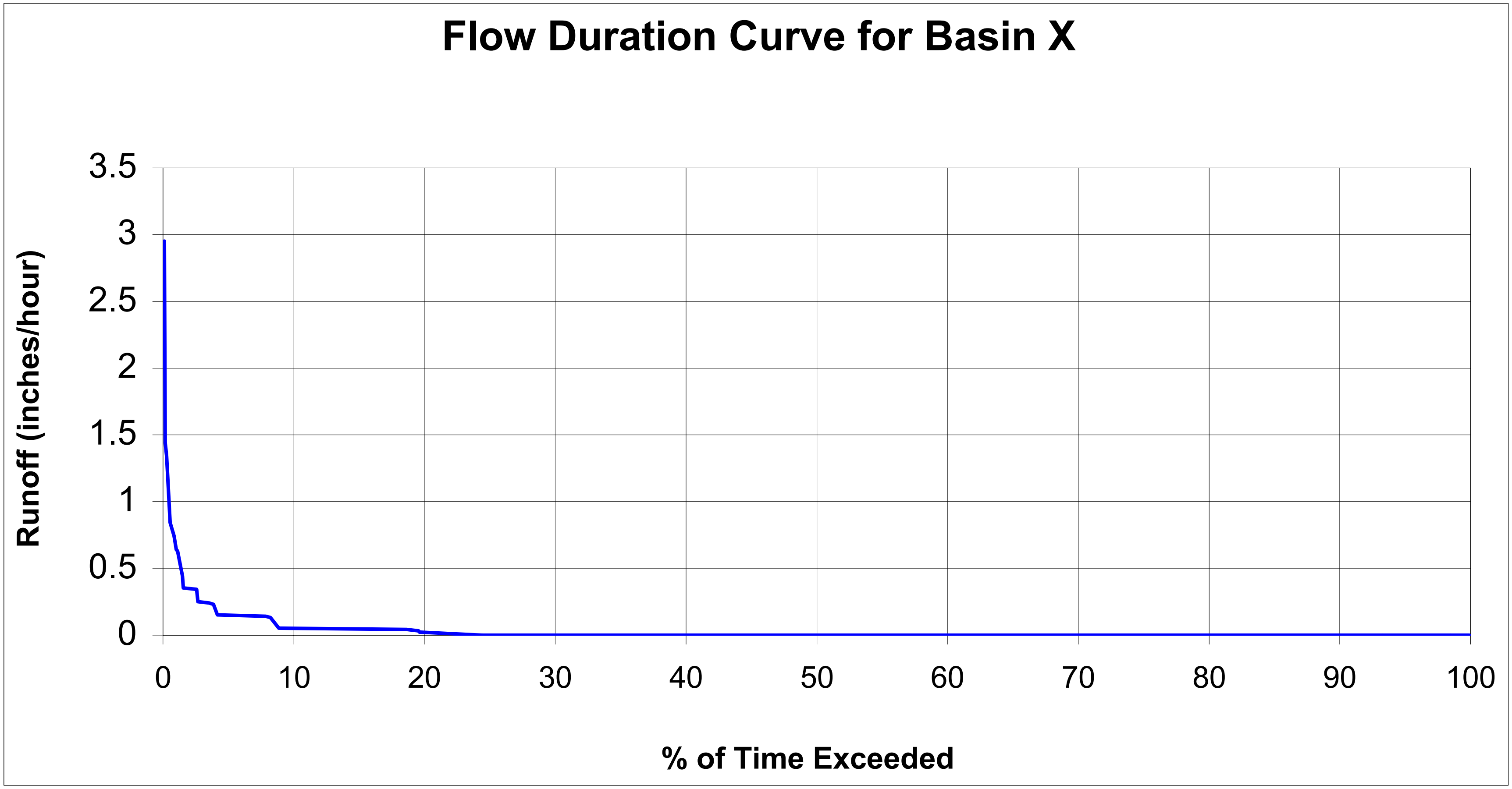

Figure A.1 Flow Duration for Griff Creek Basin.

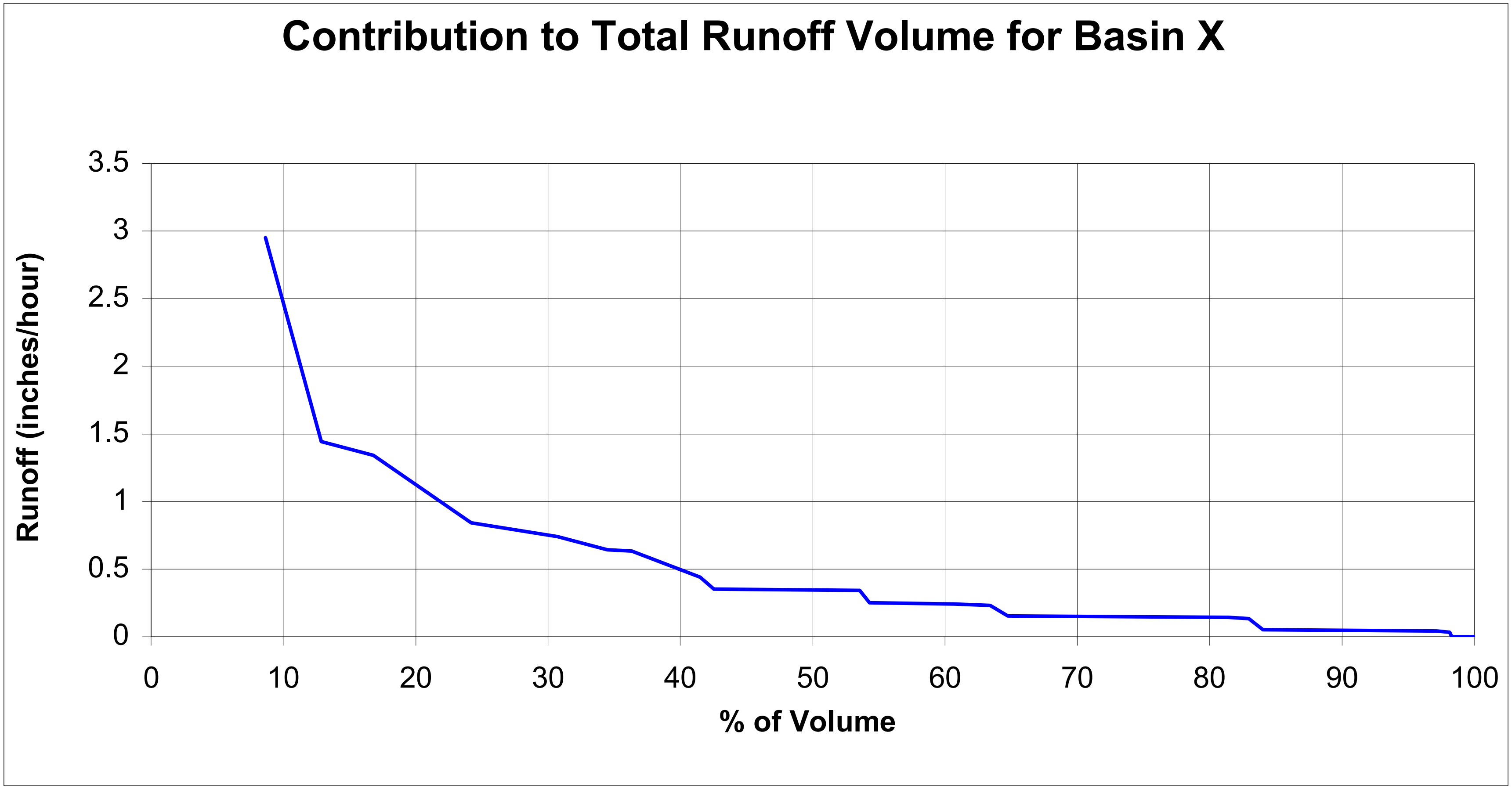

Figure A.2 Contribution to Total Runoff for Griff Creek Basin.

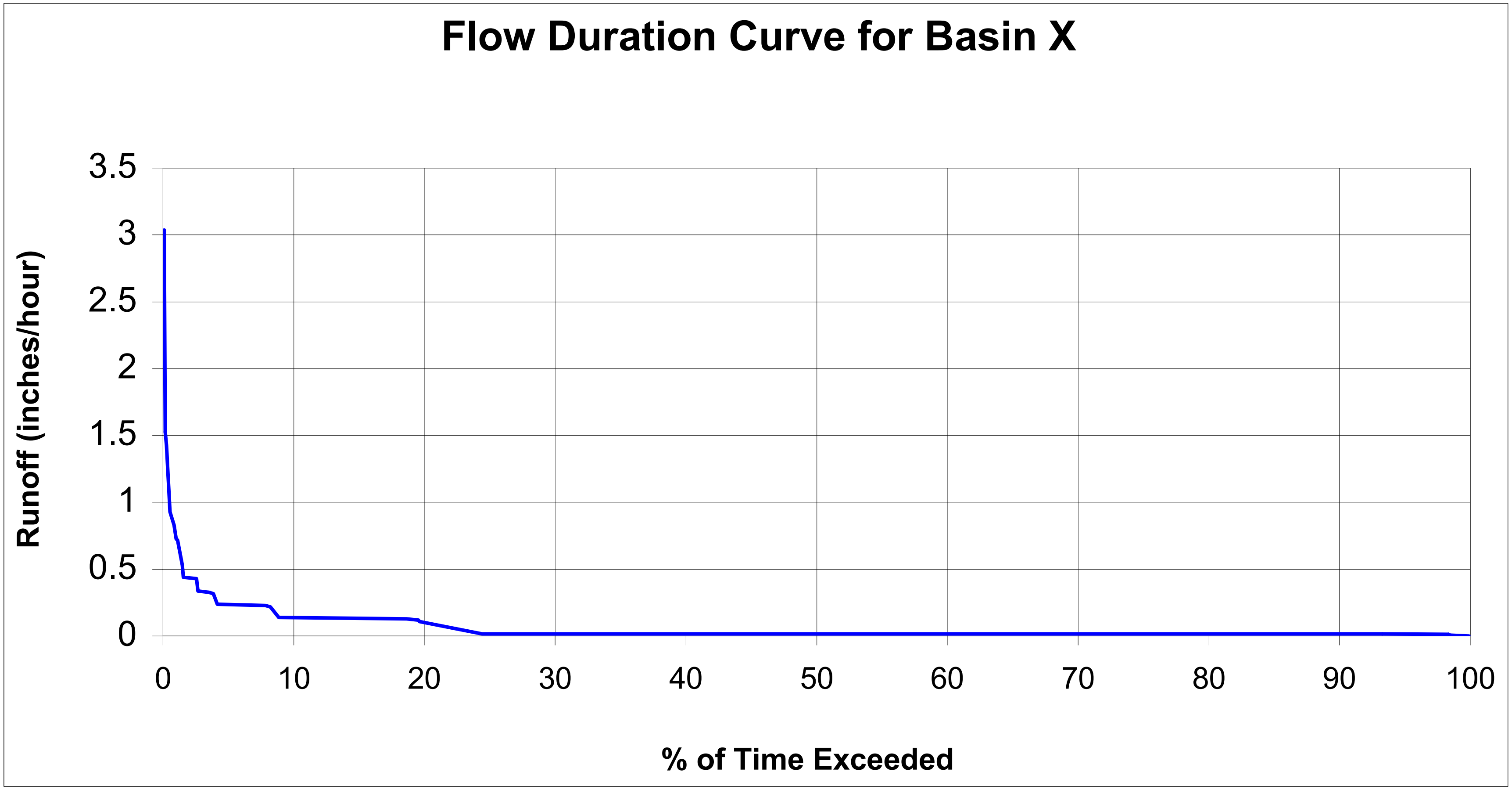

Figure A.3 Flow Duration for Deer Basin.

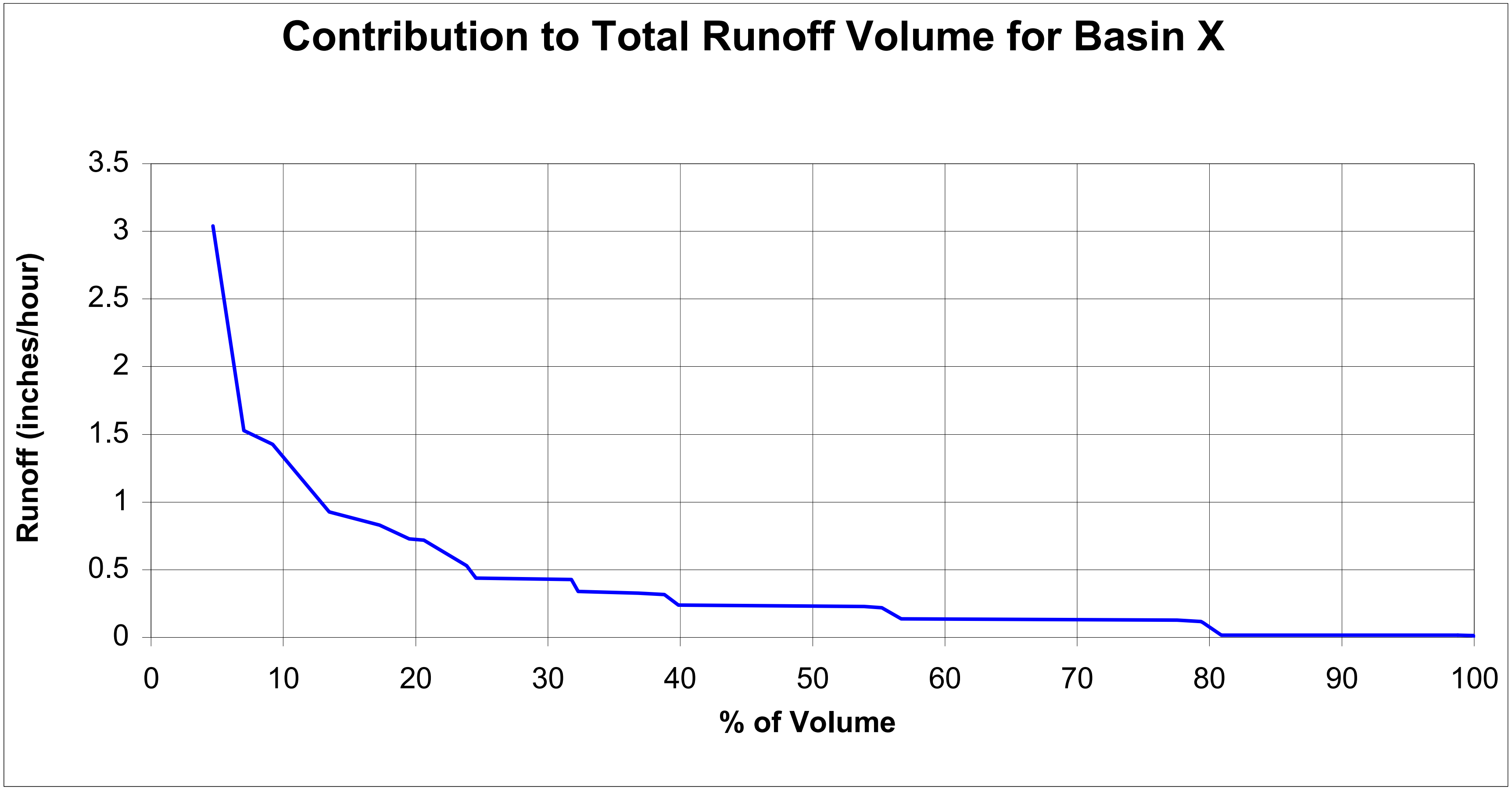

Figure A.4 Contribution to Total Runoff for Deer Basin.

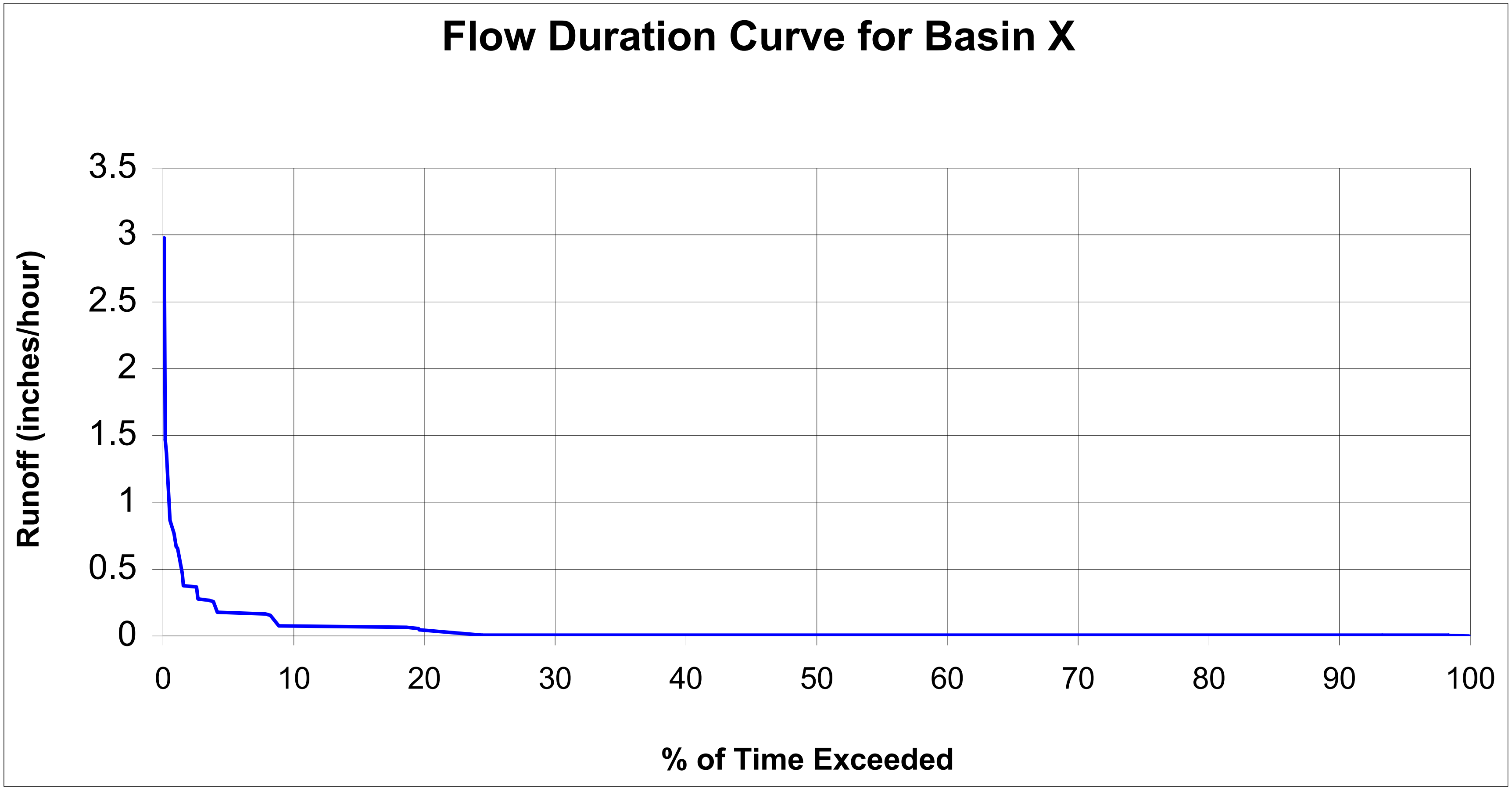

Figure A.5 Flow Duration for Bear Basin.

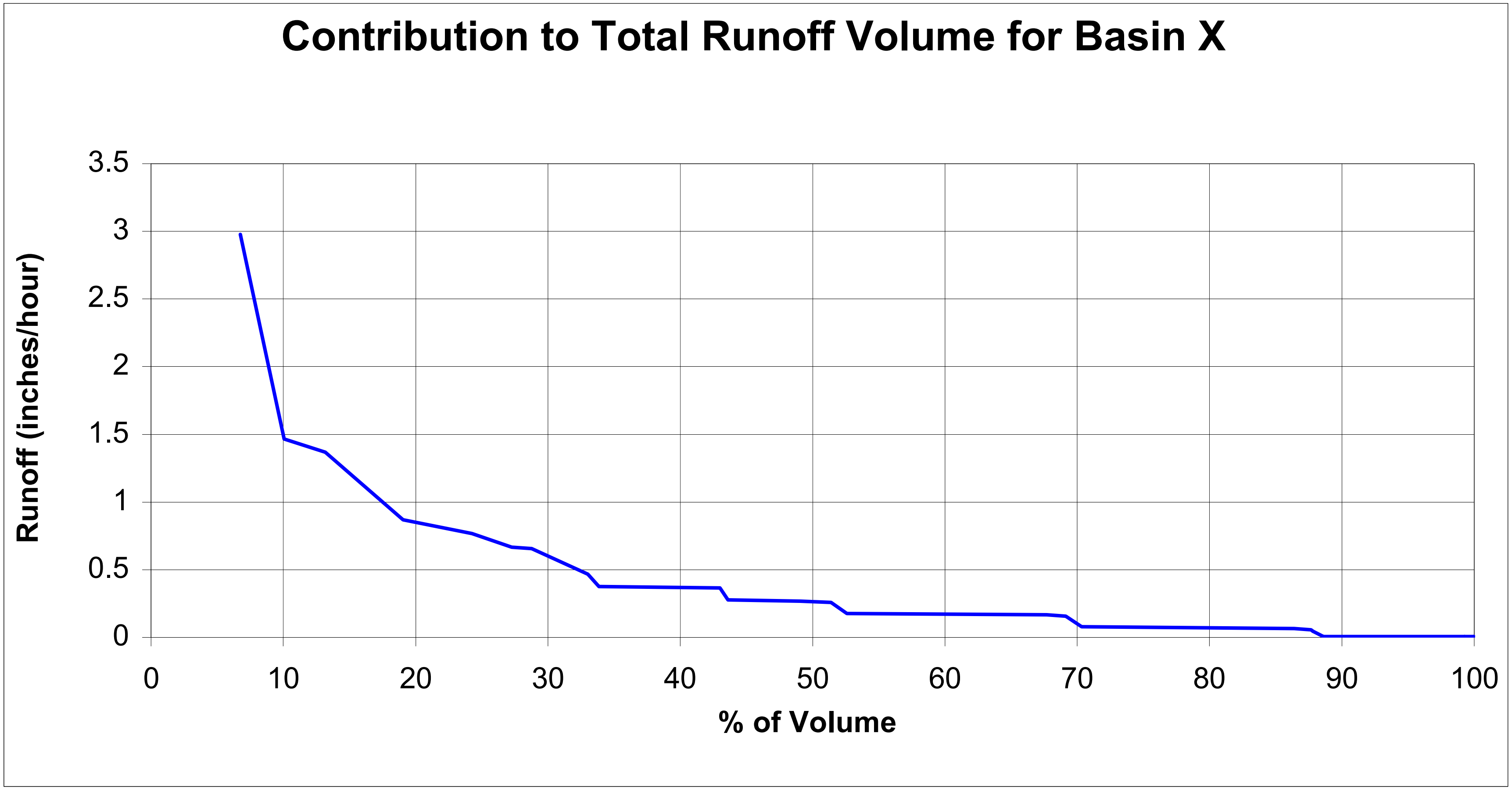

Figure A.6 Contribution to Total Runoff for Bear Basin.

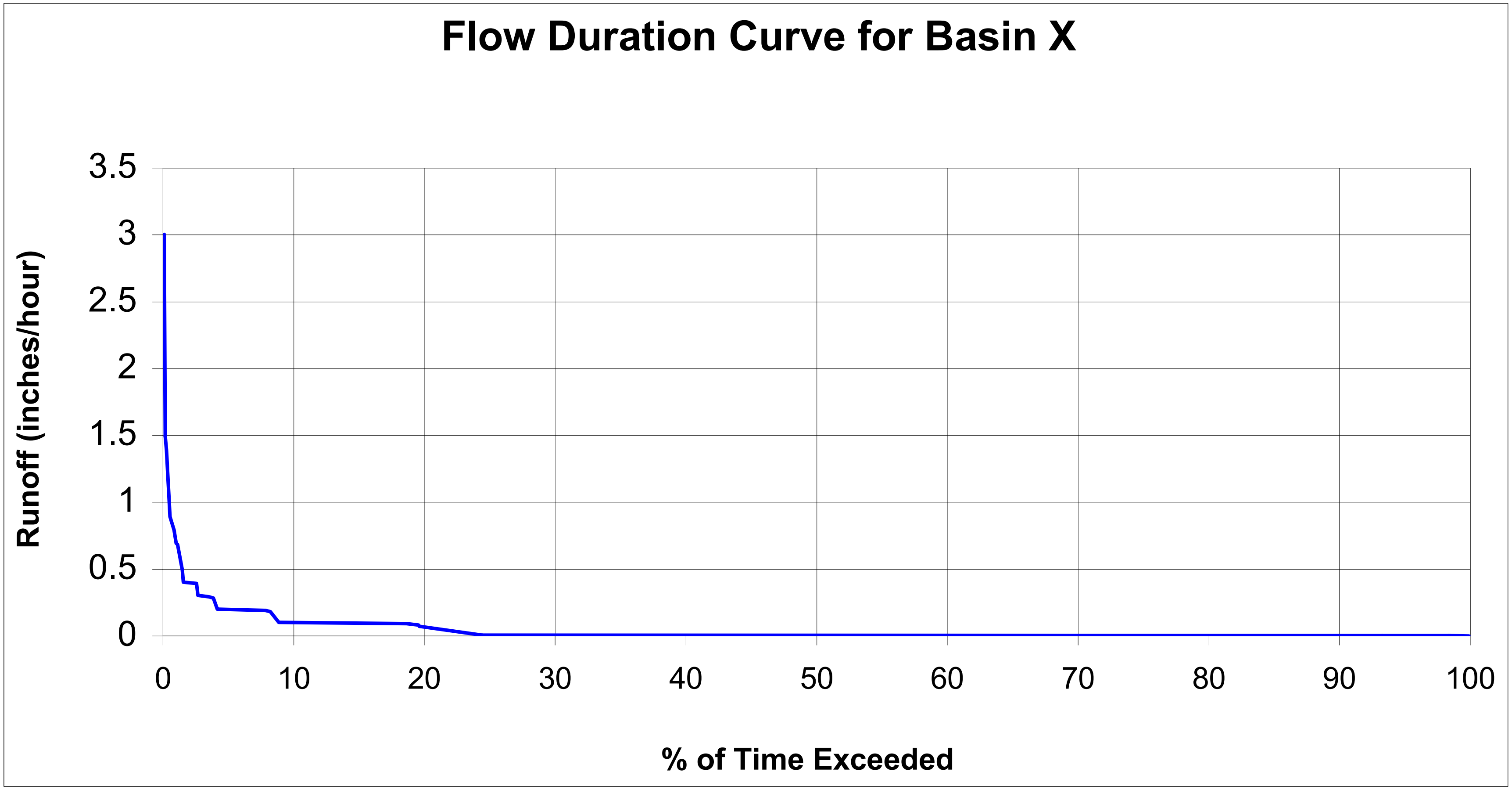

Figure A.7 Flow Duration for Coon Basin.

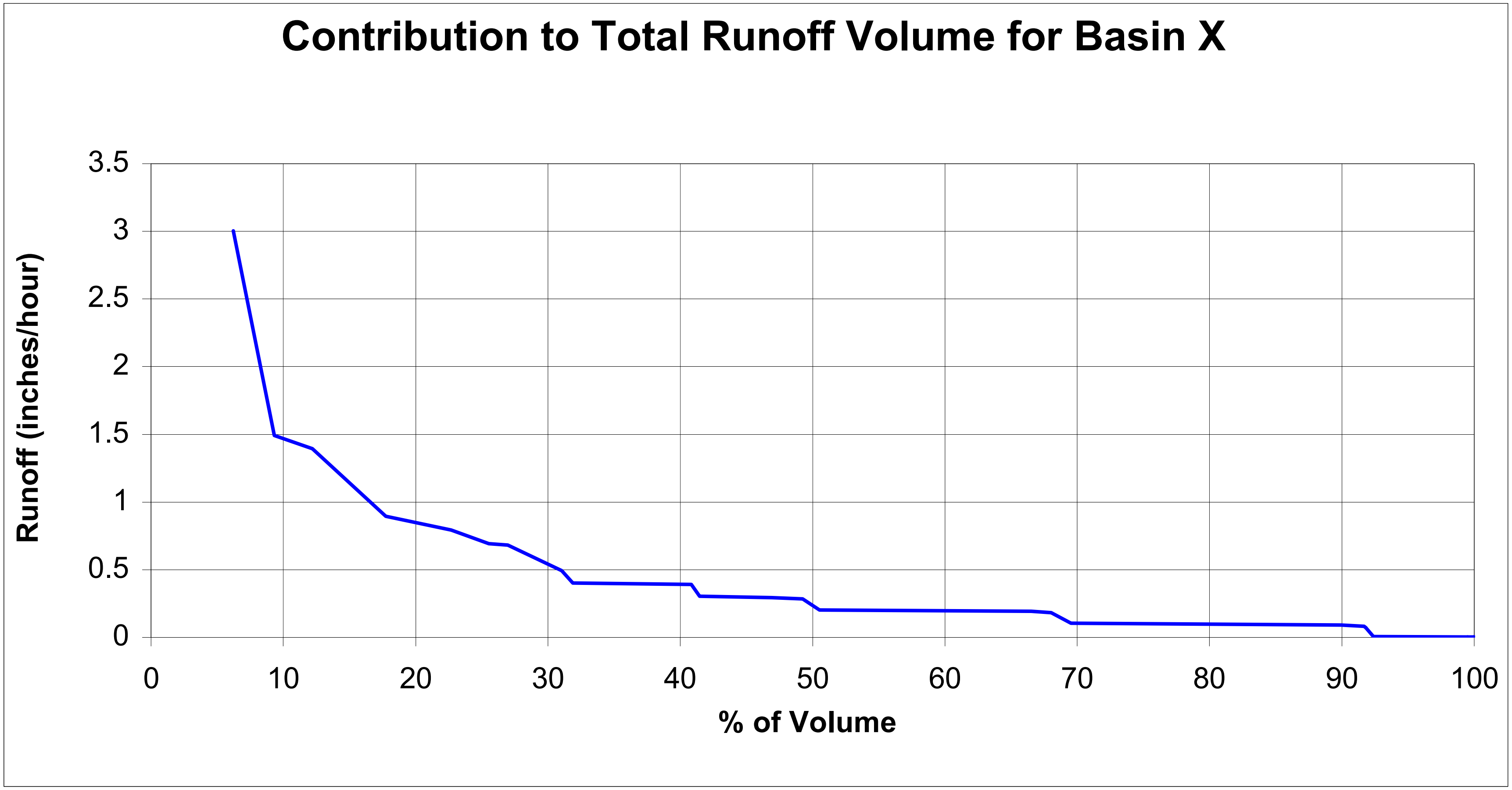

Figure A.8 Contribution to Total Runoff for Coon Basin.

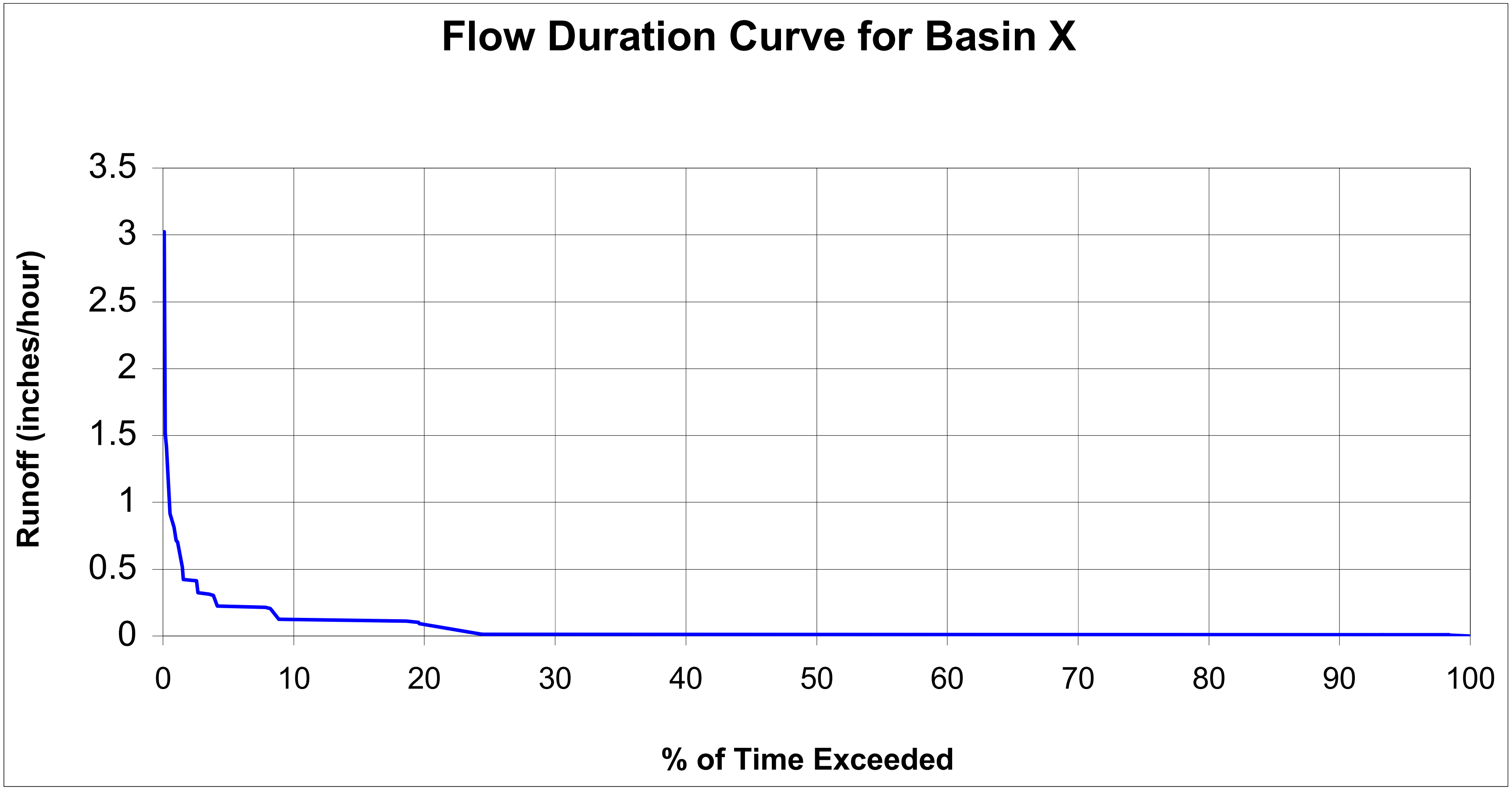

Figure A.9 Flow Duration for Fox Basin.

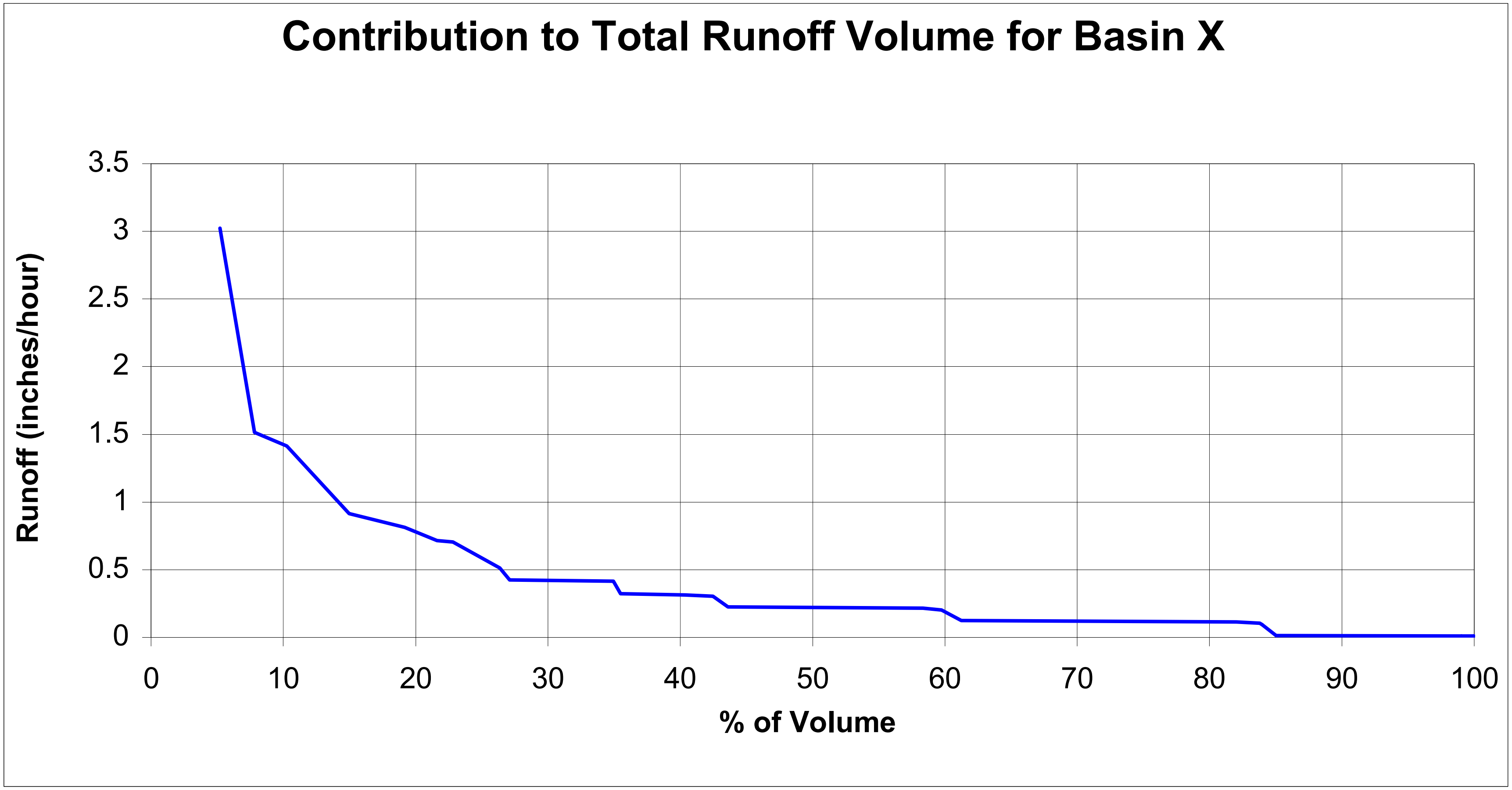

Figure A.10 Contribution to Total Runoff for Fox Basin.

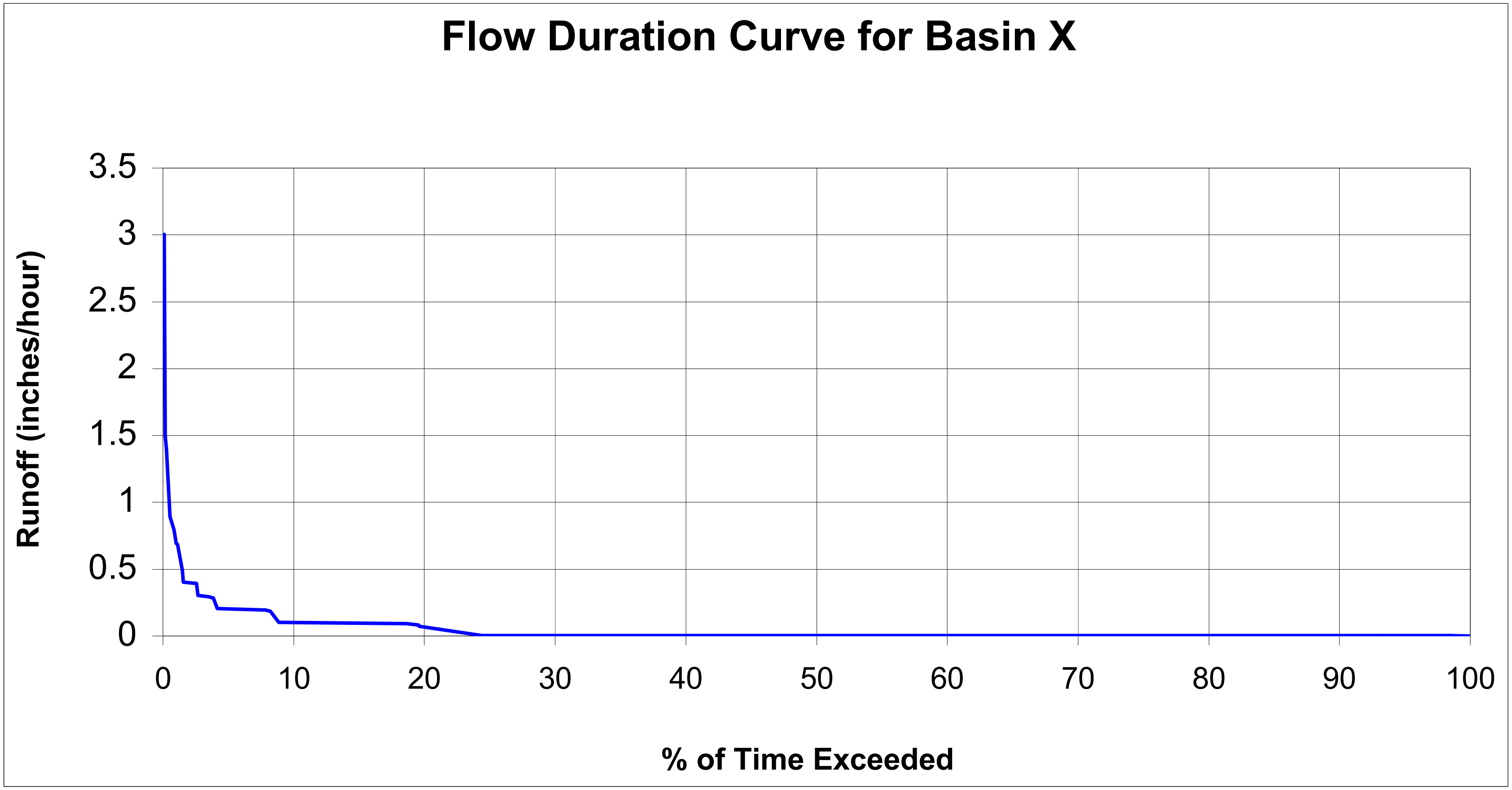

Figure A.11 Flow Duration for Beaver Basin.

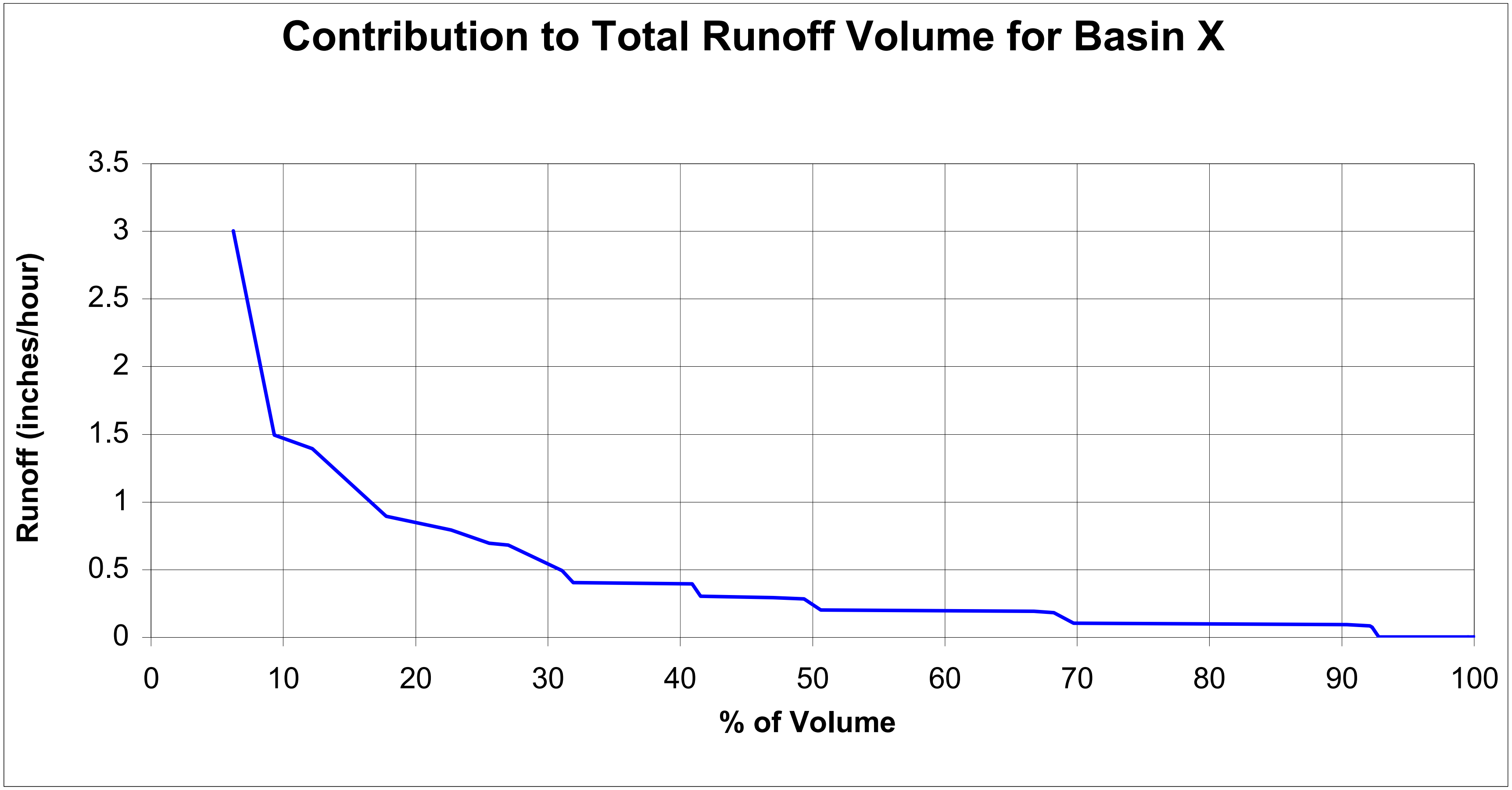

Figure A.12 Contribution to Total Runoff for Beaver Basin.

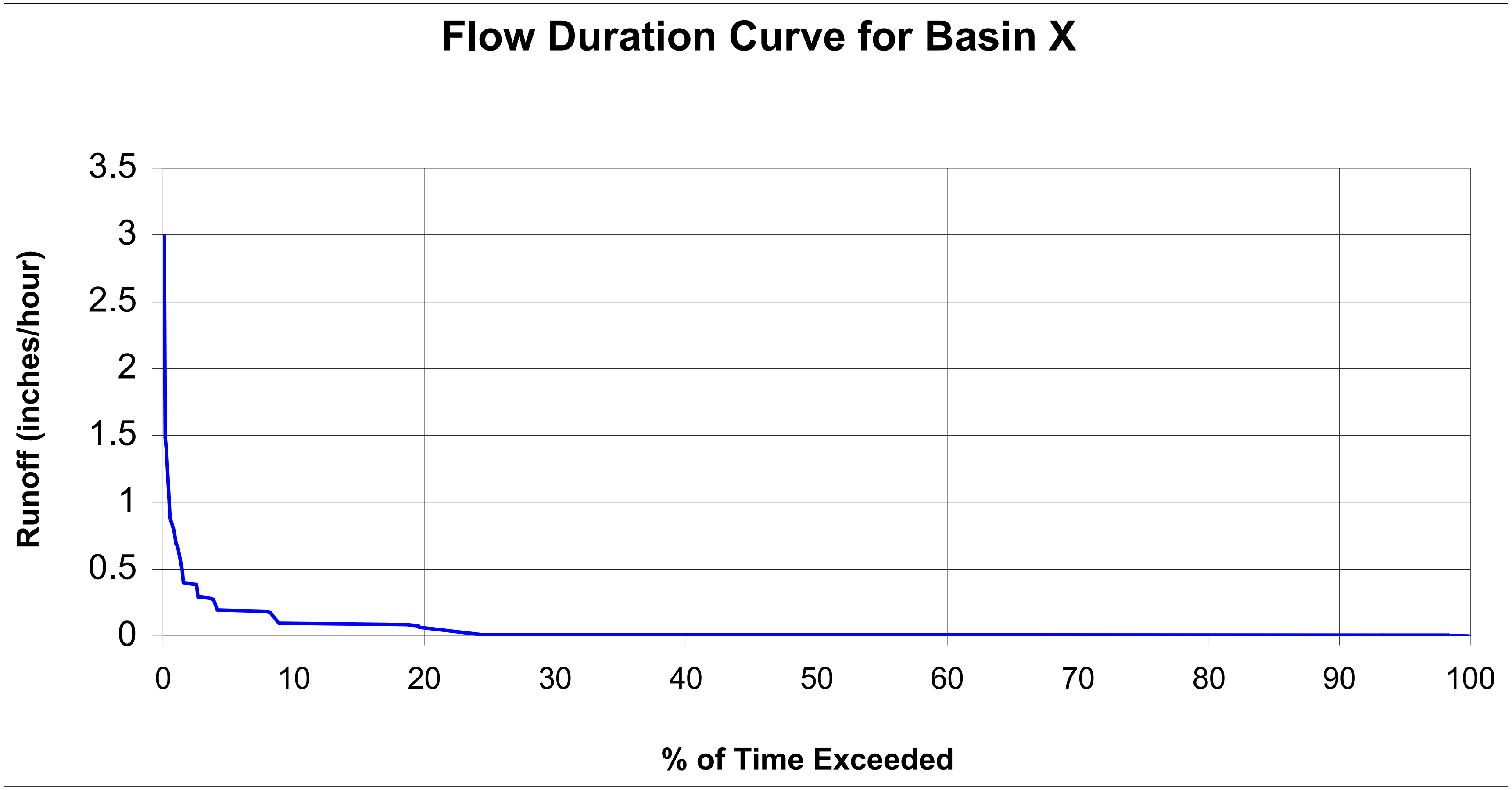

Figure A.13 Flow Duration for Beaver Basin.

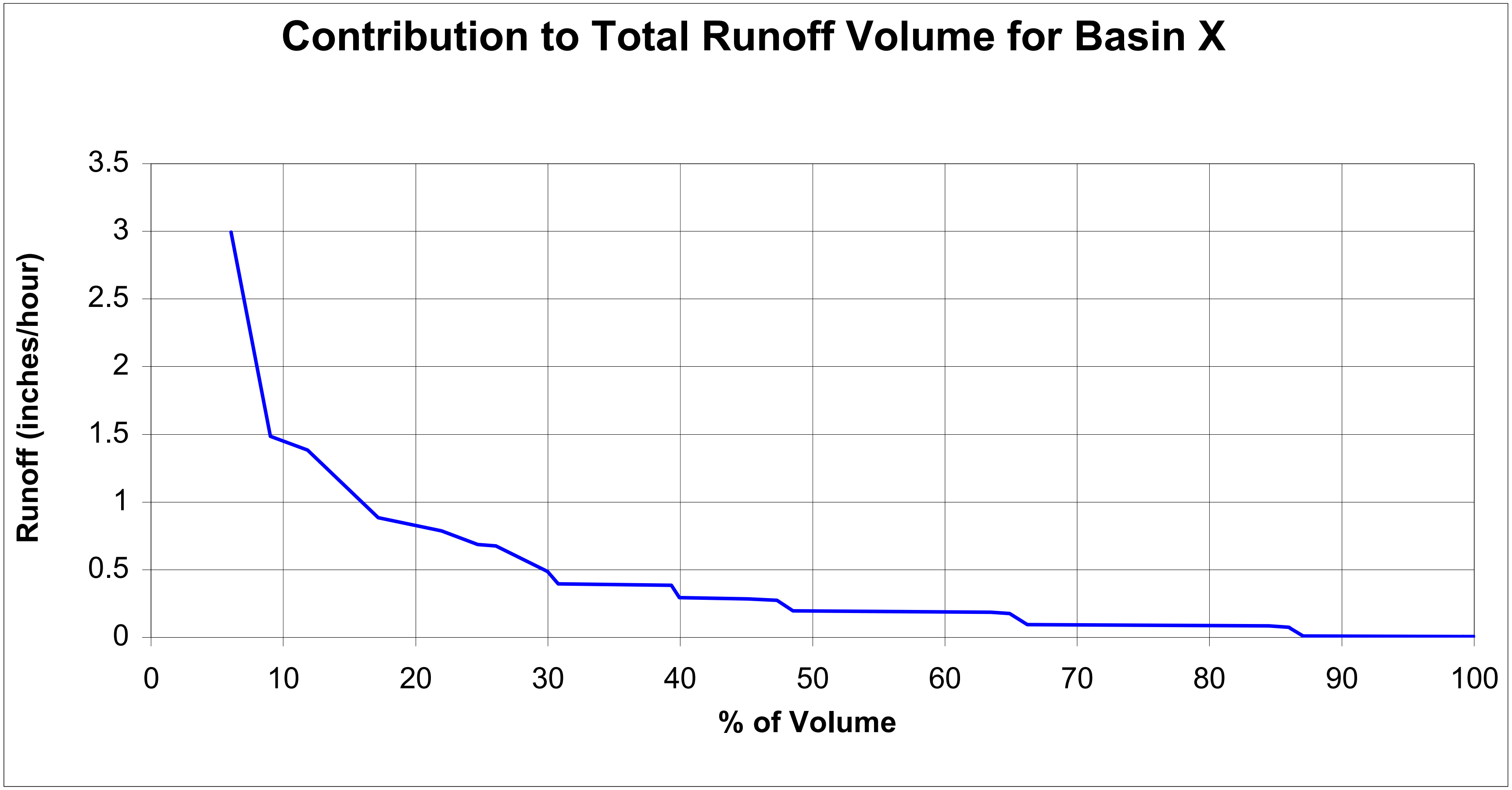

Figure A.14 Contribution to Total Runoff for Park Basin.

Appendix B

Pollutant Source Field Sheet

ENTRIX, INC.

KBWIP

Field Sheet:
Roadside Drainage System
Condition Assessment

Problem Area ID: **Date/Time:**

Assessors: **Conditions:**

Street: **Side:**

Between St: **and St:**

Affected Area, width x length or sf:

Average slope of affected area, x:1:

Area/Cover condition assessment poor, medium, good:

Area/Cover condition assessment notes:

Problem Description:

Photo References:

Photo Remarks:

Appendix C

Summary of Pollutant Sources

Table C-1. Water Quality Problems in the Project Area.

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Bear - 1	B-1_04	Speckled, west edge of pavement	SL	Eroding slope
	B-1_05	Speckled, Fairway Excavation Operations	S	Shoulder, stockpile with little to no BMPs, rock pile 50' long with no BMPS
	B-1_06	Speckled north side, looking west	SL	Eroding slope
	B-1_07	Speckled north side, looking west	S	Eroding shoulder
	B-1_08	Speckled south side, looking west	S	AC berm repair
	B-1_09	Bear/Speckled east side, looking south	S	Eroding shoulder; curb at intersection missing - sediment generated flows directly into sediment can
	B-1_10	Bear/Speckled west side, looking south	S	Eroding shoulder, curb missing
	B-1_11	Bear westside, looking south	S	Eroding shoulder
	B-1_12	Bear east, looking north	SL	Eroding slope behind swale
	B-1_13	Bear and Cutrhroat, NE corner	SL	Eroding slope behind swale
	B-1_14	Bear and Cutthroat, NW corner	S	Eroding shoulder
	B-1_15	Bear/Cutthroat, looking east	S	Eroding shoulder with vegetated swale at corner
	B-1_16	Cutthroat, north side looking west	S	Eroding shoulder
	B-1_17	Cutthroat, north side looking west	S	Eroding shoulder
	B-1_18	Cutthroat, north side looking east	S	Eroding shoulder; private lot is large sediment source
	B-1_19	Burdick Excavation Company	SL	Source for sediment/pollutants, drums, debris, etc. drainage direct to storm drain
	B-1_20	Cutthroat North side, looking east	S	Eroding shoulder
	B-1_21	Cutthroat North side, looking east	SL	Bare soil driveway, no BMPs
	B-1_22	Coon/Cutthroat north side, looking N/W	S	Eroding shoulder

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Bear - 1	B-1_23	Cutthroat, south side looking west	SL	Bare soil, disturbed
	B-1_24	Cutthroat, south side looking west	S	Bare soil along shoulder
	B-1_25	Cutthroat, south side looking east	S	Erosion along road shoulder, broken up by 2 - 15' driveways
	B-1_26	Cutthroat, south looking S/E	SL	Bare slope
	B-1_27	Bear eastside, looking south	S	Erosion along road shoulder
	B-1_28	Bear westside, looking south	S	Erosion control fabric in swale turned up and not functioning
	B-1_29	Bear, east side	C	Channel along road has little/no vegetation cover; culvert at top needs energy dissipater
	B-1_30	Bear and Dolly Varden east	O	Sediment can not functioning, needs to be re-configured to allow flow from Dolly Varden to enter more easily
	B-1_31	Bear/Dolly Varden west	O	Rock bowl or berm on Dolly Varden to prevent water from bypassing sediment can
	B-1_32	Dolly Varden, north side	S	Roadside parking for church, disturbed shoulder
	B-1_33	Dolly Varden north	S	Eroding shoulder
	B-1_34	Dolly Varden north	S	Eroding shoulder
	B-1_35	Dolly Varden north	S, SL	Shoulder and parking area disturbance
	B-1_36	Dolly Varden north	S	Shoulder and parking area disturbance
	B-1_37	Dolly Varden south	S	Eroded shoulder with 4 driveways at 15' each
	B-1_38	Dolly Varden south	S, SL	Eroding shoulder and lot
	B-1_39	Dolly Varden south	S	Bare shoulder around Dolly Varden to Bear on south side, to fit through rock channel
	B-1_40	Bear westside	C	Ditch with limited cover
	B-1_41	Bear east	C	Ditch along road
	B-1_42	Bear west	S, O	Area next to shoulder not bad, bicycle track with bare soil source; need to better define swale for proper drainage
	B-1_43	Loch Levin, north side looking west	S	Need to repair sediment trap and shoulder, wall is failing small slope contributing sediment to area
	B-1_44	Loch Levin, north side looking east	S	Shoulder and parking area

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Bear - 1	B-1_45	Loch Levin, north side looking east	S	Shoulder and parking area
	B-1_46	Loch Levin, south side looking west	SL	Corner residence needs BMPs
	B-1_47	Bear east	S	Eroding shoulder drains into pond
	B-1_48	Bear west	S	Eroding shoulder
	B-1_49	Bear west	S	Eroding shoulder
Bear-2	B-2_01	Loch Levin, south side looking west	S	A few dirt driveways onto property that need BMPS
	B-2_02	Loch Levin, south side looking west	S	Eroding shoulder
	B-2_03	Steelhead north	S	Eroding shoulder
	B-2_04	Steelhead north	S	Eroding shoulder
	B-2_05	Steelhead north	S	Eroding shoulder
	B-2_06	Steelhead north	S	Eroding shoulder
	B-2_07	Steelhead south	S	Small pieces of disturbed shoulder between paved driveways
	B-2_08	Steelhead south	S	Eroding shoulder
	B-2_09	Steelhead southeast	S	Eroding shoulder
	B-2_10	Bear west	C	Eroding channel
	B-2_11	Bear east	C	Eroding channel
	B-2_12	Bear east	S	Eroding shoulder
	B-2_13	Bear east	C	Eroding channel
	B-2_14	Bear west	S	Eroding shoulder
	B-2_15	Bear west	C	Culvert outlet poorly positioned, re-install at grade
	B-2_16	Bear east	S	Eroding shoulder
	B-2_17	Bear east	C	Eroding channel
	B-2_18	Golden north	S	Eroding shoulder
	B-2_19	Golden south	S	Eroding shoulder
	B-2_20	Golden north	S	Eroding shoulder
	B-2_21	Golden south	S	Eroding shoulder
	B-2_22	Lot at corner of Golden and Bear	SL	1/2 of lot is disturbed, needs mulch and parking barrier along edge
	B-2_23	Bear Street between Golden Street	C	Channel cut from culvert flow with low shoulder along roadside

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Bear-2	B-2_24	Bear Street	SL	Private lot with limited vegetation cover and no berm along pavement to control movement of sediment
	B-2_25	Bear Street	S	Private lot with some vegetation and gravel coverage; no berm to control sediment movement
	B-2_26	Bear Street	S	Shoulder erosion no control for sediment movement
	B-2_27	Bear Street	C	Incised channel draining into gully no rocks stabilizing banks or bottom of channel some bank erosion
	B-2_28	Rainbow Ave	S	No control over sediment delivery to pavement ~4 lots (20x50') not paved and potentially adding more sediment
	B-2_29	Rainbow Ave	S	No control over sediment; delivery to pavement low slope
	B-2_30	Rainbow Ave	S	Shoulder erosion with no vegetation or gravel to stabilize sediment; there are 4 paved lots (~50x20') 1 paved road and 2 unpaved lots (~50x50') adding more potential source material
	B-2_31	Rainbow Ave	S	Same as B2-30 including only 20' to unpaved driveways however private drives extend farther by ~30'
	B-2_32	Rainbow Ave	S	Shoulder unprotected, no control for sediment; movement near the west end there is a small gully being formed at the corner draining into constructed channel heading North to South
	B-2_33	Bear Street	S	Minor source of sediment due to good drainage in soils and good vegetation, but forming slight gully where vegetation is patchy adjacent to road
	B-2_34	Trout Street	S	Limited control to sediment input on 2nd 1/2 of site
	B-2_35	Trout Street	S	No vegetation to control sediment input gradual slope to road no berm to control sediment
	B-2_36	Trout Street	SL	Small parcel of private land with gradual slope but limited cover 2 sections separated by paved drive ~20x50' (taken out)

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Bear-2	B-2_37	Trout Street	S	No protection of sediment in narrow section but is some rock/gravel placement to protect more normal berm areas, paved break between 2 sections most eastern section is more significant sediment source (~20x100)
	B-2_38	Trout Street	S	Unprotected shoulder from erosion, includes larger lots ~ 150x200' covered in pine needles and some rock structures
	B-2_39	Bear Street	C	Unlined channel leading into culvert with limited vege some bank erosion, but limited
	B-2_40	Bear Street	S	Unprotected shoulder with limited vege slight gully forming at base of sloped area where meets road 2 sections separated by paved lot
	B-2_41	Brook	SL	Unprotected area with lots of car activity (parking facility) 2 sections separated by paved parking area
	B-2_42	Brook	S	No vegetation cover for area adjacent to road and businesses, frequented by traffic and parking
	B-2_43	Hwy 28	S	Sediment source directly over storm drain going directly into lake
	B-2_44	Hwy 28	S	Small polygon of fine sediment lining store front area mostly small but 1 larger source area, polygons not connected most used for driveways/parking lots or driven over frequently
	B2-01	Coon between SR28 and Brookway	S	Unpaved road shoulder parking for beach, free parking or are otherwise fee parking area
	B2-02	Coon between SR 28 and Brookway	S	Designated beach overflow parking
	B2-03	Brockaway Vista between Coon and Chipmunk	S	Shoulder parking free but near fee area
Beaver –1	BV-1_1	Chipmunk	S	Eroding shoulder next to driveway
	BV-1_2	Chipmunk	SL, S	Empty lot eroding to street at Salmon 30x15', road shoulder parking
	BV-1_3	end of Minnow	SL	Eroding gravel drive discharging to Chipmunk
	BV-1_4	Chipmunk	S	From Hwy to +188 shoulder exposed between AC and Rock ditch some breakdown of AC, ditch needs to be rebuilt

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Beaver –1	BV-1_5	Hwy 28	SL	Eroding lot drains to Hwy, small swale behind AC curb on hwy, lot is used for parking access to Apts, highly disturbed
	BV-1_6	Beaver	S	Eroding shoulder draining to private, bare soil
	BV-1_7	Beaver	SL	Bike trails leading downhill to private approx 5th lot into watershed
	BV-1_8	Beaver	S	Shoulder with cinders leading downhill to private
	BV-1_9	Beaver	S	Eroding shoulder along length interrupted at driveways, second lot from top is burn soil draining to road 40x40 bare soil road shoulder eroding
	BV-1_10	Beaver	S	Starting at AC curb 3rd lot from top dirt driveway for boat parking 5th lot, AC curb holding back
	BV-1_11	Beaver	S	5th lot from Bass dirt driveway eroding shoulder drains onto road
	BV-1_12	Beaver	SL	Dirt driveway on lot 9 from Bass
Coon-1	C-1_01	Chipmunk/Speckled	S	Earthen road accessing multiple driveways (some also earthen) this complex spans two watersheds measurement for entire complex
	C-1_02	Speckled	S/SL	Pull out no cover aside from very little litter loose dirt used by vehicles
	C-1_03	Speckled	S/SL	Shoulder yard complex
	C-1_04	Speckled	S/SL	Shoulder pull out area
	C-1_05	Speckled	S	Earthen road/shoulder
	C-1_06	Speckled	SL	Slopes along road partially covered by vegetation but with large bare patches
	C-1_07	Speckled	SL	Lady Luck Pack station earthen vehicle access area with minimal vegetation
	C-1_08	Speckled	SL	Steep slope relatively bare, some litter cover; already been some effort made to trap sediment by rip-rap destination before drain
	C-1_09	Coon	SL	Earthen driveway
	C-1_10	Cutthroat	C	Patchy channel drain E some bare patches in channel, on banks slope, mild at culvert on south side os street minor undercutting
	C-1_11	Cutthroat	C	Channel draining to same culvert as C--10 draining W some possible bank, slope and channel erosion

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Coon-1	C-1_12	Cutthroat	SL	Earthen driveway
	C-1_13	Cutthroat	S	Earthen shoulder with associated earthen yards, minimal cover from litter, gravel, and vegetation; some slope erosion from mound at west end or polygon
	C-1_14	Cutthroat	S	Earthen shoulder yard
	C-1_15	Cutthroat	SL	Earthen driveway horseshoe shape
	C-1_16	Cutthroat	SL	Earthen yard loose earth some litter
	C-1_17	Dolly Varden	SL	Yard little to no cover many vehicles
	C-1_18	Dolly Varden	SL	Earthen driveway very little gravel
	C-1-19	Dolly Varden	S	Shoulder with several bare yards little to no litter
	C-1_20	Dolly Varden	S	Shoulder with some vegetation rock, gravel also 3 earthen driveways bare channel base
	C-1_21	Dolly Varden	B	Bare area on bank of channel
	C-1_22	NE<Dolly Varden/Coon	S	Earthen road no cover and shoulder with minimal vegetation cover shoulder included with C-1_20
	C-1_23	Coon	SL	Steep sparely vegetated slope next to house driveways
	C-1_24	Coon/Loch Levon	B	Large bare patches around culvert
	C-1_25	Loch Levon	S	Shoulder with small narrow bare patches but some
	C-1_26	Loch Levon	S	Shoulder has mulch on it
	C-1_27	Loch Levon	C	Shoulder, bank and channel bare and vulnerable to erosion; channel sediment source along entire block
	C-1_28	Loch Levon	S	Shoulder some vegetation and cover
	C-1_29	Loch Levon	S	Continuation of C1-28 (map break) include partially earthen driveway 1 yard
	C-1_30	Fox/Loch Levon	SL	Good litter cover but steepness of slope may result in litter being inadequate
	C-1_31	Fox	S	Shoulder and yard with some litter/gravel cover
	C-1_32	Fox	C	Channel exposed through rip-rap
	C-1_50	Trout Street	S	Unprotected shoulder adjacent to road with larger private lot above shoulder lot is undeveloped ~100x200' requires BMPS

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Coon-1	C-1_51	Trout Street	S	Fairly well protected aside from loss of vegetation close to road and private property to E pond area itself is well vegetated and stable drainage would most likely be absorbed by this area
	C-1_52	Trout Street	S	No protection for sediment movement drainage has larger lot to north but well vegetated and unpaved drive
	C-1_53	Trout Street	SL	Limited protection for undeveloped lot that seems to be used for RV hook ups drains into concrete swale
	C-1_61	Fox	S	Unprotected shoulder with no control for sediment movement includes 1 unpaved drive ~20x80' that may add potential sediment
	C-1_62	Golden/Fox Corner	SL	Unprotected private drive used continuously
	C-1_63	Golden Ave	S	No protection for sediment movement includes: 5 paved drives, 4 large unpaved drives ~30x50'
	C-1_64	Coon Street	C	No protection of sediment movement along roadside; channel showing signs of erosion down to drain, 2 paved drives separating total area, some bank erosion; accumulation of pine needles surrounding drain potential blocking water access
	C-1_65	Coon Street	C	Some unprotected patches of sediment also have some photo degradable erosion control mesh at south and being exposed
	C-1_66	Coon Street	S, C	Unprotected shoulder from sediment delivery, channel adjacent to unit mid-way through has blocked culvert due to sediment intrusion, Coon St ECP erroneously identifies drainage pattern of Coon Creek; drainage follows natural alignment and not constructed ditches, erosion
	C-1_67	Coon Street	S	Unprotected shoulder with additional undeveloped drive no control for sediment movement
	C-1_68	Golden Ave	SL	Highly used parking area not developed for stability drains into Coon Creek swale area
	C-1_69	Golden Ave	S	Unprotected shoulder with active use by cars, includes: 2 paved drives, 3 unpaved drives extending 10x30'

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Coon-1	C-1_70	Golden	B	Eroding bank of culvert channel, culvert is full of material, alignment of Coon Creek has been altered; further investigation necessary potential sediment source
	C-1_71	Golden/Coon	SL	Potential sediment Source due to disturbed area within plot; area is surrounded by trees and vegetation so natural drainage may control sediment input
	C-1_72	Golden	SL	Not enough protection of slope toward drain
	C-1_73	Golden	S	Small sources associated with fences, broken-down pavement, shoulders includes 4 paved drives, 2 unpaved drives between parcels
	C-1_74	Golden	SL	Large source of sediment due to slope and unprotected area
	C-1_75	Golden	SL	Large source of sediment similar to C1-74
	C-1_76	Fox	S	No erosion control for shoulders next to pavement includes 1 paved drive
	C-1_77	Steelhead Street	S	No erosion control for shoulder next to pavement, includes 7 paved drives, 4 unpaved drives
	C-1_78	Steelhead Street	SL	Large source of material in undeveloped private lot
	C-1_80	Coon Street	S	No erosion control for shoulder includes 1 paved drive
	C-1 _81	Steelhead Street	SL	No erosion control of unpaved driveway that drains directly into Coon Creek
	C-1_82	Steelhead Street	S	No erosion control and drains into Coon Creek, starting to form gully
	C-1_83	Coon Street	S	Steep slope with no erosion control, starting to form gully, used as parking area drains into Coon Creek mostly
	C-1_84	Coon Street	B	Eroding bank of culvert channel, culvert is full of material, alignment of Coon Creek has been altered; further investigation necessary; potential eroding bank into channel exposure of erosion fence
	C-1_85	Steelhead Street	S	Uncontrolled sediment for erosion purposes along shoulder includes: 9 paved drives, 3 unpaved drives

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Coon-1	C-1_86	Steelhead Street	C	Mostly uncontrolled channel with eroding banks and incised thalweg, perched culvert under driveway (west section), grouted culvert at street corner, 1 paved drives sep. sections
	C-1_87	Fox	S	No erosion control for sediment movement, shoulder forming gully as sediment transported down hill
Coon-2	C-2_01	Fox /Trout	S	Bare shoulder some cover from litter and vegetation
	C-2_02	Trout	S	Shoulder with some cover from litter
	C-2_03	Coon	B	Previous erosion control efforts failing in section of channel wood slats falling; also, foot path including erosion
	C-2_04	Brook	S	Shoulder bare, some cover from litter
	C-2_05	Brook/Coon	S	Shoulder some litter
	C-2_06	Coon	S	Shoulder and pull out area bare
	C-2_07	Brook	S	Some litter cover
	C-2_08	Brook	S	Some litter cover
	C-2_09	Fox	S	Little to no litter cover some vegetation.
	C-2_10	Salmon	S	Little to no vegetation 3 paved driveways 2 parking lots
	C-2_11	Salmon	S	Some vegetation.
	C-2_12	28 N	S	Bare shoulder info hospice store
	C-2_13	28 N	S	Shoulder without litter, 1 large, 1 medium bare parking areas associated with business (scraps) behind bare shoulder
	C-2_14	SR	SL	Dirt lot east of tattoo parlor looks like may get very muddy
	C-2_54	1/2 Trout, 1/2 Fox (rounding corner)	S	Limited protection from erosion drains directly into concrete swale
	C-2_55	Rainbow Ave	S	Unprotected shoulder with no control over sediment movement area broken-up by 5 1 the size of 3 paved driveways, 1 unpaved drive and 1 larger undeveloped area with vegetation (~20x100")
	C-2_56	Rainbow Ave	S	No protection for sediment movement with active parking along edge area contains: 2 paved/graveled drives, 1 vegetated swale, 1 vegetated lot, 1 unvegetated lot (~30x80')

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Coon-2	C-2_57	Rainbow Ave	S	No protection from erosion along shoulder includes 2 unpaved drives and 1 gravel covered drive
	C-2_58	Rainbow Ave	SL	Slope eroding into asphalt swale; at west end of site drainage is crossing road to north side instead of draining into gutter area includes 2 undeveloped lots with no vegetation (~20x50')
	C-2_59	Rainbow Ave	SL	No protection from erosion 3 sections broken up by 2 paved drives drains into asphalt swale
	C-2_60	Rainbow Ave	SL	No protection from erosion area (mid-section) includes unpaved drive with signs of rill or gully forming area used as private parking area
Cutthroat/ Coon	CC-1	Dolly Varden	SL	Some erosion occurring from patchy vegetation cover draining into concrete channel
	CC-10	Cutthroat Street north	SL	Some erosion getting into concrete channel
	CC-2	Dolly Varden	SL	Eroding slope between rock wall and concrete channel, drains to channel
	CC-3	Dolly Varden	SL	Eroding slope same as previous
	CC-4	Chipmunk	S	No erosion control of shoulder, parcels separated by 2 paved drives
	CC-5	Beaver	S	No erosion control of shoulder
	CC-6	Cutthroat Street north	S	No erosion control for sediment movement
	CC-7	Chipmunk	S	No erosion control for sediment movement
	CC-8	Chipmunk	SL	Large erosion source due to sloped area and no protection for erosion, creating gully near bottom of unit 2x5'
	CC-9	Speckled	SL	Large source material with slope, along powerline ROW
Deer-1	D-1_01	South side of Speckled Ave between Deer and Wolf St	Sl	Slope erosion with curb breakdown; there is no berm to slow down drainage; also have vegetation removal that would stabilize sediment more
	D-1_02	Deer Street between Speckled Avenue and Private Gate	S	Erosion along private property line and road (pavement); there are rivulets throughout area making braided channel through sediment

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Deer-1	D-1_03	Deer Street between Speckled Avenue and Private Gate	SL	There is a slope along the pavement that is slightly eroding and creating a gully where the slope meets the pavement; sediment would be transported down the road that has a slope of <4:1 private owner is making improvements to the bank area
	D-1_04	Speckled Ave between Deer Street and Bear Street	SL	Unpaved driveway, took affected area up to Placer County easement but extends ~50'
	D-1_05	Speckled Ave between Deer Street and Bear Street	C	Sediment filled gully running into culvert banks are stable, and slope is gradual, small berm at top of sloped area (near pavement) but ineffectual
	D-1_06	Speckled Ave between Deer Street and Bear Street	SL	Could be a problem in major storms; mostly unprotected area with vegetation, but covered in gravel; there is a slight berm before slope that protects the area from most of pavement runoff; some broken pieces of berm; unit curves around corner next to
	D-1_07	Speckled Ave between Deer Street and Bear Street	C	Culvert is creating channel from run-off sediment land area with very low gradient banks; channel is ~30' from road, downstream of culvert
	D-1_08	Deer	SL	Earth driveway no gravel
	D-1_09	Dear	S	Bare shoulder broken by 1 medium driveway
	D-1_10	Speckled Ave North	C	Channel formed by culvert built-up fine sediment with no berm to stop transport down road
	D-1_11	Cutthroat Street north	S	Shoulder erosion with private property that extend back ~100' all with some sediment source material
	D-1_12	Cutthroat	S	Bare lot with uncovered ground
	D-1_13	Cutthroat	S	Some yards with litter cover but overall continuous, break where road slope increase drastically
	D-1_14		S	Shoulder erosion along property line no berm or rock to stop transport of sediment
	D-1_15	Cutthroat	S	Steep slope with bare patches all on steep part of street

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Deer-1	D-1_16		SL	Large source of sediment input from private land-cleared but undeveloped for the most part
	D-1_17	Deer	S	Extend ~ 100 ft west of road narrow been driven upon curves onto cutthroat
	D-1_18		S	Unprotected shoulder along row draining into culvert
	D-1_19	Cutthroat	S	Bare shoulder level with road
	D-1_20		S	Shoulder starting to form slight gully with input into rock covered culvert, low gradient slope
	D-1_21	Cutthroat	S	Shoulder/driveway yard little veg. some litter some gravel
	D-1_22	Deer Street	SL	Vegetation becomes patchy along slope, creating instability sediment accumulating at bottom of slope and creating gully
	D-1_23	Deer	C	Cover includes shoulder and bank channel with eroding base and banks; full length of street broken by 1 drive way
	D-1_24		SL	Slope with private property that has signs of erosion near bottom of slope
	D-1_25	Dolly Varden	S	Bare shoulder some litter cover some veg. cover
	D-1_26	Dolly Varden	S	Shoulder erosion very low gradient slope with narrow swath of sediment along road; there are 5 paved driveways separating the sediment areas and 3 large unpaved driveways potentially adding sediment
	D-1_27	Dolly Varden	S	Bare shoulder 15' average depth at one point, yard extends back (n) ~40' (area used to park cars)
	D-1_28	Dolly Varden	S	Shoulder erosion very low gradient very narrow affected area; four paved driveways separating sediment areas
	D-1_29	Deer	C	Some vege. in channel, banks, shoulder well vegetated base of channel has short to long patches of bare ground few bare banks minor
	D-1_30	Deer Street	C	Channel forming going toward culvert
	D-1_31	Deer	S	Large field with relatively good vegetation some foot/bike paths, however, may contribute to erosion

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Deer-1	D-1_32	Deer Street	S	Possible input from car disturb along road parking; little to no vegetation cover
	D-1_33	Deer	SL	3 bare patches broken up by two entrances to PL each patch ~28'long 22', 22', and 10' deep respectively
	D-1_34	Deer Street	SL	Mostly unprotected slope with root exposure formation of gully below slope separated by 1 paved driveway
	D-1_35	Deer	B	Steep ~50% bare banks channel bare fine (litter, rock, vegetation)
	D-1_36	Steelhead Street	S	Shoulder erosion but very minimal due to narrow swath and paved driveways; there are 2 paved driveways one very large one (~50') and 3 unpaved driveways with length size extending ~50'
	D-1_37	Steelhead	S	Long strip of shoulder plus "yard" in front of boys and girls club trails
	D-1_38	Loch Lawn	S	Shoulder erosion narrow swath with low gradient slope separated by 11 paved driveways ~20' long and 1 unpaved driveway extending back ~50'
	D-1_39	Steelhead	SL	Sparely vegetated slope along street forming gully parallel to street
	D-1_40	Golden	S-SL	Both sides of Deer have earthen shoulder broken by paved drive ways both sides
	D-1_41	Steelhead	S	Bare shoulder with 2 significant larger earthen driveways
	D-1_42	Golden	S	Both sides of Deer have earthen shoulder broken by paved drive ways both sides
	D-1_43	Loch Levon	S	Several large, bare, yards/lots continuous bare shoulder broken by driveways runs ~ full length of block
	D-1_44	Deer	S	Shoulder with minimal vegetation some gravel some litter used by vehicle some driveways paved
	D-1_45	Deer	S	Shoulder with minimal vegetation some litter some paved driveways
	D-1_46	Golden	S/SL	Shoulder ~50% bare also yards with gravel, mulch, litter, vegetation driveway break up
	D-1_47	Golden	S	Shoulder ~50% bare also yards with gravel, mulch, litter, vegetation driveway break up

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Deer-1	D-1_48	Deer	C	Channel with large patches of bare channel, bank and slope. Main problem areas from missing rip-rap and bare foot trails
	D-1_49	Deer	SL	Yard of Apts bare used a driveway pretty compacted ~1/2 covered by asphalt
	D-1_50	Rainbow	S	Shoulder but with some litter some bare yard with minimal litter
	D-1_51	Rainbow	S	Shoulder but with some litter some bare yard with minimal litter
	D-1_52	Rainbow	S	Bare patch with sediment and litter near culverts at either end (off Rainbow and Trout)
	D-1_53	Trout	S	Shoulder covered in place by litter used frequently by cars to park
	D-1_54	Trout	S	Shoulder covered in place by litter used frequently by cars to park
	D-1_55	Trout	C	Channel with rip-rap and vegetation but some bare patches
	D-1_56	Deer	S	Bare shoulder used by vehicles
	D-1_57	Deer	SL	Open lot with litter but also bare ground behind church property gated; large dirt mound holding cross
	D-1_58	Deer	S	Bare shoulder
	D-1_59	Rainbow	S	Bare shoulder with large driveway (paved) breaking up continuity; some litter
	D-1_60	Rainbow	S	Bare shoulder with large lot (bare)
Fox-1	F-1_01	Chipmunk	S	Exposed shoulder with no erosion control, however cover is in good condition, 1 paved drive, 1 unpaved area to garden
	F-1_02	Chipmunk	SL	No erosion control or berm to prevent movement of material
	F-1_03	Chipmunk	S, SL	No erosion control for shoulders, includes one paved drive
	F-1_04	Beaver	B	Natural lined channel eroding on upper bank not incising too much, some blockage of culverts with pine needles
	F-1_05	Beaver	SL	Slight erosion problem areas along slope, draining directly into concrete channel, add rodent hole areas, 4 paved drives separating section

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Fox-1	F-1_06	Beaver	SL, S	No erosion control for sediment movement and steep grade, there have been multiple gullies forming intermittently down west hillslope due to extreme slope to region, gullies forming along shoulder, 21 paved drives between sections/1 unpaved
	F-1_07	Loch Lawn	S	No erosion control for sediment movement and steep grade to road, 6 paved drives separating sections, 1 gully formation south from pavement
	F-1_08	Fox	S	No erosion control for sediment movement, 2 paved drives between sections, small gully forming at south end of unit
	F-1_09	Steelhead Street	S	No erosion control for sediment movement, drainage not functioning properly according to land owner
	F-1_10	Steelhead Street	S	No erosion control for sediment. Movement, drainage not functioning properly according to land owner
	F-1_11	Fox	C	Unprotected from erosion, shoulder forming a deeper gully from water movement, erosion along bank exposing erosion fence
	F-1_12	Fox	SL	Limited control of erosion, 1 drive separating sections, drains directly into concrete swale, improper drainage through are pine needles
	F-1_13	Golden	SL	No erosion control drains directly into swale, 4 paved drives between sections, 1 unpaved
	F-1_14	Golden	S, SL	No erosion control, some gullies being formed by erosion forces, 1 paved drive separating sections not draining into storm drainages
	F-1_15	Fox	C	No erosion control for "earthen swale" very shallow no signs of incision except very close to culvert entrance, exposed erosion fence, culvert filling with sediment making it close to non-function, 1 paved drive between 2 sections
	F-1_16	Rainbow Ave	S	No erosion control, creating gully down slope
	F-1_17	Rainbow Ave	SL	No erosion control, private drive with slope
	F-1_18	Rainbow Ave	S	No erosion control, 4 paved drives separate sections

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Fox-1	F-1_19	Fox	SL	Some erosion of slope around degrading waddles and absent berm, drains into concrete side
	F-1_20	Trout	S	No erosion control, 5 paved drives separating area
	F-1_21	Trout	SL	No erosion control for private lot, steep slope
	F-1_22	Trout	S	No erosion control, 1 paved drives separate sections, 3 unpaved
	F-1_23	Fox	S	No erosion control, 1 paved drives/parking area separate area
	F-1_24	Brook	S	Partial ditch convey water bare ground eroding, cinders crushed AC debris, trash, parking at east end
	F-1_25	Brook	SL	Parking at end of street on dirt in ROW and along. ROW
	F-1_26	Brook	S	Parking at end of street on dirt in ROW and along ROW
	F-1_27	Brook	SL	No vegetation yard, driveway individual lot outside ROW
	F-1_28	Fox south of Brook	S	AC swale with parking behind sediment in AC swale lot at corner of Salmon no parking but bare shoulder behind AC swale
	F-1_29	Salmon	S	Eroding shoulder, partial ditch convey water bare ground eroding, cinders crushed AC debris, trash, parking at east end
	F-1_30	Salmon	SL	Parking area in back of apt. is bare drains to road
Fox-2	F-2_01	Salmon	S	Eight paved driveways, 1 unpaved driveway, 2 bare yards,
	F-2_02	Fox	S	Bare shoulder with large lot associated
	F-2_03	28 N	S	Bare shoulder used for paring deep dirt looks like would get very muddy
	F-2_04	Minnow	S	Shoulder with little to no litter private property with bare yard loose dirt in driveway/right of way (yard not included in measurement behind fence)
	F-2_05	28 N	S	Bare shoulder east of movie theater

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Fox-2	F-2_06	28 N	S	Bare shoulder east of Jaliscos in front of 8727 and 1/2 of property immediately west
	F-2_07	Minnow	S	Shoulder bare several properties have broken down asphalt and are therefore sediment sources
	F-2_08	Minnow	S	Some litter cover variable depth avg ~10'
Griff-3	G-3_01	Speckled, North Shore to Wolf: North Side	C	Earthen swale coming around corner from Northshore Boulevard is down cutting with evidence of deposition where flow spreads and crosses Speckled
	G-3_02	Speckled, North Shore to Wolf: South Side	B	Small sluffing bank wasting into flowline
	G-3_03	Speckled, North Shore to Wolf: Between end 25.5' from Griff Creek Centerline	C	Eroding gully discharging to Griff Creek (may be partially on private property)
	G-3_04	Speckled, Wolf to Crest G-3_03: North Side	B	Rock-lined ditch in poor condition; likely source under high flows; steep sides of ditch sloughing
	G-3_05	Speckled, Wolf to Crest G-3_03: Adjacent to Rockwood, Inc.	SL	Oversteepened bank with sloughing material
	G-3_06	Speckled, Wolf to Crest G-3_03: South Side	S	Disturbed shoulder, compacted and bare with evidence of use
	G-3_07	Speckled, Wolf to Crest G-3_03:	SL	Oversteepened slope with historical grading and possible wider use
	G-3_08	Wolf, Speckled to Dolly Varden: West Side	B	Rock-lined ditch showing evidence of localized breakdown; 1:1 channel sides
	G-3_09	Wolf, Speckled to Dolly Varden: East Side	B	Broken down rock-lined channel; downcutting and bringing in rock-lining; major jumble
	G-3_10	Cutthroat, Wolf to Top G3: North Side	B	Broken down rock-lined channel; downcutting and bringing in material; south side with no identifiable problems
	G-3_11	Dolly Varden from Wolf to Northshore: North Side	C	Broken down rock-lined ditch, possibly undersized, allowing flow from W side Wolf to cross street and aggravate problem area G3_14
	G-3_12	Dolly Varden from Wolf to Northshore. R/W portion of dirt parking	S	Bare area subject to egress

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Griff-3	G-3_13	Dolly Varden from Wolf to Northshore: V-Ditch coming from around corner from Northshore Blvd.	C	V-shallow dirt swale coming around corner. Bare with flow
	G-3_14	Dolly Varden from Wolf to Northshore	SL	Series of areas where high flows spill over AC curb and slope was headcut up to/under curb; there are several curb breaks that are in need of reworking
	G-3_15	Dolly Varden between Wolf	S	Shoulder disturbance with gully formed upstream of pipe crossing
	G-3_16	Dolly Varden between Wolf	S	Slight to moderate vehicular shoulder disturbance
	G-3_17	Secline between Steelhead and Golden	SL	Over steepered slope with spot erosion area (or portion thereof) has been previously treated.
	G-3_18	SR 267 between SR 28 and Dolly Varden	S	Disturbed road shoulder
	G-3_19	SR 267 between sR 28 and Speckled	S	Shoulder disturbance bicycle and pedestrian traffic
	G-3_20	SR 267 between Dolly Varden and Speckled	S	Vehicular shoulder disturbance due to egress partly powdery surface
	G-3_21	Wolf between Dolly Varden and Steehead	SL	Turf field could become nutrient source depending on fertilizer maintenance practices coupled with precipitation patterns; no tail water control
	G-3_22	SR 267 between SR 28 and Dolly Varden	PL	Potential problem due to potential anerobic conditions in constructed wetland and leading to orthophosphate formation ESP as this area apparently relieves some tail water from golf course
Park-1	P-1-01	Beaver	S	Dirt turn out bare soil crumbling at approximately below 3rd house from end of Perk at end of shoulder rock
	P-1-02	Beaver	S	Eroding cut bank shoulder 145' uphill of spring add 40' downhill from spring cut slope little
	P-1-03	Beaver	SL	Dirt driveway/parking
	P-1-04		SL	Dirt pull out
	P-1-05	Beaver	S	Dirt pull out from Highway uphill on Beaver for drains to provide bare soil

Table C-1. Water Quality Problems in the Project Area (continued).

Drainage Basin	Problem ID#	Problem Location	Problem Type[1]	Problem Description
Park-1	P-1-06	Perk	S	Numerous pull-outs unpaved numbered on map
	P-1-07	Perk	S	Dirt pull-out
	P-1-08	Perk	S	Numerous pull-outs north of Bend St
	P-1-09	Perk	SL	Barren hillslope eroding onto road
	P-1-10	Bend	SL	Bare shoulder and driveway from parking
	P-1-11	Bend	SL	Bare shoulder from parking
	P-1-12	Bend	S	Bare shoulder from parking
Speckled-1	S-01	Secline between SR 28 and Lake Tahoe	SL	Picnic area is disturbed due to foot traffic use coupled with poorly designated circulation
	S-02	Secline between SR 28 and Lake Tahoe	S	Parking area for Secline off of paved shoulder
	S-03	Brockaway Vista Between Selline and East	S	Unpaved roadway with beach parking
	S-04	Secline between SR 28 and Lake Tahoe	PL	This potential problem area is a sanitary sewer lift station (apparently low location) could be subject to exfiltration or infiltration depending on groundwater level

[1] Source Type either S-Shoulder Erosion, Sl-Slope Erosion, C-Channel Erosion, B-Bank Erosion
[2] Slope either <2:1 (2:1 or Steeper), 2:1 - 4:1, or >4:1 (4:1or Flatter)

Appendix D

Source Area Ranking

Table D-1. Kings Beach Ranking Table

	Relative Importance Factors		Ranking Class Definitions		
Slope:	Weight Factor:	1	Upper Limit:	<2:1	
	Relative Contribution:	33%	Lower Limit:	>4:1	
Area:	Weight Factor:	1	Upper Limit:	600	sf
	Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:	Weight Factor:	1	Upper Limit:	Good	na
	Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:	Weight Factor:	0	Upper Limit:	Not Used	ac
	Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		***Area***		***Condition***		***Risk***		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
Bear Basin									
B-1_04	2:1 - 4:1	2	200	1	Medium	2			5
B-1_05	>4:1	1	24500	3	Poor	3			7
B-1_06	>4:1	1	500	1	Poor	3			5
B-1_07	>4:1	1	150	1	Medium	2			4
B-1_08	>4:1	1	28	1	Medium	2			4
B-1_09	>4:1	1	5	1	Poor	3			5
B-1_10	>4:1	1	120	1	Poor	3			5
B-1_11	>4:1	1	350	1	Poor	3			5
B-1_12	>4:1	1	450	1	Poor	3			5
B-1_13	>4:1	1	810	2	Poor	3			6
B-1_14	>4:1	1	630	2	Poor	3			6
B-1_15	>4:1	1	250	1	Medium	2			4
B-1_16	>4:1	1	400	1	Poor	3			5
B-1_17	>4:1	1	400	1	Poor	3			5
B-1_18	>4:1	1	1240	2	Poor	3			6
B-1_19	>4:1	1	2500	3		2			6
B-1_20	>4:1	1	304	1	Poor	3			5
B-1_21	>4:1	1	900	2	Poor	3			6
B-1_22	>4:1	1	280	1	Poor	3			5
B-1_23	>4:1	1	600	1	Poor	3			5

Table D-1. Kings Beach Ranking Table (continued)

		Relative Importance Factors		Ranking Class Definitions		
Slope:		Weight Factor:	1	Upper Limit:	<2:1	
		Relative Contribution:	33%	Lower Limit:	>4:1	
Area:		Weight Factor:	1	Upper Limit:	600	sf
		Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:		Weight Factor:	1	Upper Limit:	Good	na
		Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:		Weight Factor:	0	Upper Limit:	Not Used	ac
		Relative Contribution:	0%	Lower Limit:	Not Used	ac

Problem ID#	*Slope* Average Slope	Slope Class, (1-3)	*Area* Estimated Area, ft^2	Area Class, (1-3)	*Condition* Cover/ Condition	Condition Class, (1-3)	*Risk* Tributary Area, ac	Hydro. Risk Class, (1-3)	Problem Ranking
B-1_24	>4:1	1	640	2	Poor	3			6
B-1_25	>4:1	1	1600	2	Poor	3			6
B-1_26	2:1 - 4:1	2	400	1	Poor	3			6
B-1_27	>4:1	1	434	1	Medium	2			4
B-1_28	>4:1	1	560	1	Medium	2			4
B-1_29	>4:1	1	1600	2	Poor	3			6
B-1_30		2	300	1	Medium	2			5
B-1_31		2	200	1	Medium	2			5
B-1_32	>4:1	1	1710	2	Poor	3			6
B-1_33	>4:1	1	420	1	Poor	3			5
B-1_34	>4:1	1	400	1	Poor	3			5
B-1_35	>4:1	1	2220	3	Poor	3			7
B-1_36	>4:1	1	600	1	Medium	2			4
B-1_37	2:1 - 4:1	2	2400	3	Poor	3			8
B-1_38	2:1 - 4:1	2	325	1	Poor	3			6
B-1_39	>4:1	1	300	1	Poor	3			5
B-1_40	>4:1	1	265	1	Medium	2			4
B-1_41	>4:1	1	375	1	good	1			3
B-1_42	>4:1	1	3200	3	Medium	2			6
B-1_43	>4:1	1	450	1	Poor	3			5

Table D-1. Kings Beach Ranking Table (continued)

	Relative Importance Factors		Ranking Class Definitions		
Slope:	Weight Factor:	1	Upper Limit:	<2:1	
	Relative Contribution:	33%	Lower Limit:	>4:1	
Area:	Weight Factor:	1	Upper Limit:	600	sf
	Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:	Weight Factor:	1	Upper Limit:	Good	na
	Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:	Weight Factor:	0	Upper Limit:	Not Used	ac
	Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		***Area***		***Condition***		***Risk***		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
B-1_44	>4:1	1	1600	2	Medium	2			5
B-1_45	>4:1	1	2450	3	Poor	3			7
B-1_46	>4:1	1	1200	2	Medium	2			5
B-1_47	>4:1	1	1560	2	Poor	3			6
B-1_48	>4:1	1	144	1	Good	1			3
B-1_49	>4:1	1	400	1	Poor	3			5
B-2_01	>4:1	1	1900	2	Poor	3			6
B-2_02	>4:1	1	1160	2	Poor	3			6
B-2_03	>4:1	1	400	1	Poor	3			5
B-2_04	>4:1	1	340	1	Poor	3			5
B-2_05	>4:1	1	490	1	Poor	3			5
B-2_06	>4:1	1	175	1	Poor	3			5
B-2_07	>4:1	1	600	1	Poor	3			5
B-2_08	>4:1	1	1065	2	Medium	2			5
B-2_09	>4:1	1	2500	3	Poor	3			7
B-2_10	>4:1	1	750	2	Poor	3			6
B-2_11	>4:1	1	480	1	Good	1			3
B-2_12	>4:1	1	800	2	Poor	3			6
B-2_13	>4:1	1	400	1	Good	1			3
B-2_14	>4:1	1	450	1	Poor	3			5

Table D-1. Kings Beach Ranking Table (continued)

	Relative Importance Factors		Ranking Class Definitions		
Slope:	Weight Factor:	1	Upper Limit:	<2:1	
	Relative Contribution:	33%	Lower Limit:	>4:1	
Area:	Weight Factor:	1	Upper Limit:	600	sf
	Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:	Weight Factor:	1	Upper Limit:	Good	na
	Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:	Weight Factor:	0	Upper Limit:	Not Used	ac
	Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		***Area***		***Condition***		***Risk***		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
B-2_15		2	850	2	Good	1			5
B-2_16	>4:1	1	1400	2	Poor	3			6
B-2_17	>4:1	1	1400	2	Good	1			4
B-2_18	>4:1	1	1845	2	Poor	3			6
B-2_19	>4:1	1	3250	3	Poor	3			7
B-2_20	>4:1	1	810	2	Poor	3			6
B-2_21	>4:1	1	1500	2	Poor	3			6
B-2_22	2:1 - 4:1	2	150	1	Medium	2			5
B-2_23	>4:1	1	738	2	Poor	3			6
B-2_24	>4:1	1	1600	2	Poor	3			6
B-2_25	>4:1	1	200	1	Medium	2			4
B-2_26	>4:1	1	406	1	Poor	3			5
B-2_27	>4:1	1	300	1	Medium	2			4
B-2_28	>4:1	1	750	2	Poor	3			6
B-2_29	>4:1	1	495	1	Poor	3			5
B-2_30	>4:1	1	2475	3	Poor	3			7
B-2_31	>4:1	1	3100	3	Poor	3			7
B-2_32	>4:1	1	900	2	Poor	3			6
B-2_33	>4:1	1	450	1	Good	1			3
B-2_34	>4:1	1	396	1	Medium	2			4

Table D-1. Kings Beach Ranking Table (continued)

	Relative Importance Factors		Ranking Class Definitions		
Slope:	Weight Factor:	1	Upper Limit:	<2:1	
	Relative Contribution:	33%	Lower Limit:	>4:1	
Area:	Weight Factor:	1	Upper Limit:	600	sf
	Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:	Weight Factor:	1	Upper Limit:	Good	na
	Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:	Weight Factor:	0	Upper Limit:	Not Used	ac
	Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		***Area***		***Condition***		***Risk***		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
B-2_35	>4:1	1	1575	2	Poor	3			6
B-2_36	>4:1	1	400	1	Poor	3			5
B-2_37	>4:1	1	825	2	Poor	3			6
B-2_38	>4:1	1	1500	2	Poor	3			6
B-2_39	>4:1	1	824	2	Medium	2			5
B-2_40	>4:1	1	1728	2	Poor	3			6
B-2_41	>4:1	1	3510	3	Poor	3			7
B-2_42	>4:1	1	300	1	Poor	3			5
B-2_43	>4:1	1	225	1	Poor	3			5
B-2_44	>4:1	1	7488	3	Poor	3			7
B2-01	<2:1	3	1200	2	Poor	3			8
B2-02	<2:1	3	4320	3	Medium	2			8
B2-03	>4:1	1	4320	3	Medium	2			6
Beaver Basin									
BV-1_1	2:1 - 4:1	2	192	1	Poor	3			6
BV-1_2	<2:1	3	2748	3	Poor	3			9
BV-1_3	<2:1	3	3750	3	Poor	3			9
BV-1_4	<2:1	3	564	1	Poor	3			7
BV-1_5	2:1 - 4:1	2	3000	3	Poor	3			8
BV-1_6	>4:1	1	400	1	Poor	3			5
BV-1_7	<2:1	3	90	1		2			6

Table D-1. Kings Beach Ranking Table (continued)

	Relative Importance Factors		Ranking Class Definitions		
Slope:	Weight Factor:	1	Upper Limit:	<2:1	
	Relative Contribution:	33%	Lower Limit:	>4:1	
Area:	Weight Factor:	1	Upper Limit:	600	sf
	Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:	Weight Factor:	1	Upper Limit:	Good	na
	Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:	Weight Factor:	0	Upper Limit:	Not Used	ac
	Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		***Area***		***Condition***		***Risk***		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
BV-1_8	>4:1	1	384	1	Poor	3			5
BV-1_9	2:1 - 4:1	2	381	1	Poor	3			6
BV-1_10	>4:1	1	1500	2	Medium	2			5
BV-1_11	<2:1	3	571	1	Poor	3			7
BV-1_12	<2:1	3	300	1	Poor	3			7
Coon Basin									
C-1_01	>4:1	1	14400	3	Poor	3			7
C-1_02	>4:1	1	120	1	Poor	3			5
C-1_03	>4:1	1	3200	3	Medium	2			6
C-1_04	>4:1	1	1400	2	Poor	3			6
C-1_05	>4:1	1	600	1	Poor	3			5
C-1_06	2:1 - 4:1	2	2000	3	Medium	2			7
C-1_07	>4:1	1	2000	3	Poor	3			7
C-1_08	2:1 - 4:1	2	200	1	Poor	3			6
C-1_09	>4:1	1	poor	3	Poor	3			7
C-1_10	>4:1	1	360	1	Medium	2			4
C-1_11	>4:1	1	480	1	Medium	2			4
C-1_12	>4:1	1	1000	2	Poor	3			6
C-1_13	>4:1	1	6000	3	Medium	2			6
C-1_14	>4:1	1	6000	3	Medium	2			6
C-1_15	>4:1	1	3200	3	Poor	3			7

Table D-1. Kings Beach Ranking Table (continued)

	Relative Importance Factors		Ranking Class Definitions		
Slope:	Weight Factor:	1	Upper Limit:	<2:1	
	Relative Contribution:	33%	Lower Limit:	>4:1	
Area:	Weight Factor:	1	Upper Limit:	600	sf
	Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:	Weight Factor:	1	Upper Limit:	Good	na
	Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:	Weight Factor:	0	Upper Limit:	Not Used	ac
	Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		***Area***		***Condition***		***Risk***		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
C-1_16	>4:1	1	3600	3	Poor	3			7
C-1_17	>4:1	1	2400	3	Poor	3			7
C-1_18	>4:1	1	1800	2	Poor	3			6
C-1-19	>4:1	1	4800	3	Medium	2			6
C-1_20	>4:1	1	7200	3	Medium	2			6
C-1_21	2:1 - 4:1	2	75	1	Medium	2			5
C-1_22	2:1 - 4:1	2	1200	2	Poor	3			7
C-1_23	2:1 - 4:1	2	1500	2	Medium	2			6
C-1_24	2:1 - 4:1	2	225	1	Medium	2			5
C-1_25	>4:1	1	120	1	Medium	2			4
C-1_26	>4:1	1	480	1	Medium	2			4
C-1_27	>4:1	1	3720	3	Medium	2			6
C-1_28	>4:1	1	2300	3	Medium	2			6
C-1_29	>4:1	1	1500	2	Medium	2			5
C-1_30	2:1 - 4:1	2	1360	2	Medium	2			6
C-1_31	>4:1	1	2800	3	Medium	2			6
C-1_32	>4:1	1	120	1	Medium	2			4
C-1_50	>4:1	1	1640	2	Poor	3			6
C-1_51	>4:1	1		1		2			4
C-1_52	>4:1	1	2400	3	Poor	3			7

Table D-1. Kings Beach Ranking Table (continued)

	Relative Importance Factors		Ranking Class Definitions		
Slope:	Weight Factor:	1	Upper Limit:	<2:1	
	Relative Contribution:	33%	Lower Limit:	>4:1	
Area:	Weight Factor:	1	Upper Limit:	600	sf
	Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:	Weight Factor:	1	Upper Limit:	Good	na
	Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:	Weight Factor:	0	Upper Limit:	Not Used	ac
	Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		***Area***		***Condition***		***Risk***		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
C-1_53	>4:1	1	1800	2	Medium	2			5
C-1_61	>4:1	1	1650	2	Poor	3			6
C-1_62	>4:1	1	10000	3	Poor	3			7
C-1_63	>4:1	1	526	1	Poor	3			5
C-1_64	>4:1	1	828	2	Poor	3			6
C-1_65	>4:1	1	680	2	Medium	2			5
C-1_66	>4:1	1	2630	3	Medium	2			6
C-1_67	>4:1	1	2505	3	Poor	3			7
C-1_68	>4:1	1	2400	3	Poor	3			7
C-1_69	>4:1	1	1320	2	Poor	3			6
C-1_70	>4:1	1	150	1	Medium	2			4
C-1_71	>4:1	1	5000	3	Medium	2			6
C-1_72	>4:1	1	120	1	Medium	2			4
C-1_73	>4:1	1	1008	2	Poor	3			6
C-1_74	2:1 - 4:1	2	10000	3	Poor	3			8
C-1_75	2:1 - 4:1	2	3750	3	Poor	3			8
C-1_76	2:1 - 4:1	2	5725	3	Poor	3			8
C-1_77	>4:1	1	3450	3	Poor	3			7
C-1_78	>4:1	1	4000	3	Poor	3			7
C-1_80	>4:1	1	1240	2	Poor	3			6

Table D-1. Kings Beach Ranking Table (continued)

		Relative Importance Factors		Ranking Class Definitions		
Slope:		Weight Factor:	1	Upper Limit:	<2:1	
		Relative Contribution:	33%	Lower Limit:	>4:1	
Area:		Weight Factor:	1	Upper Limit:	600	sf
		Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:		Weight Factor:	1	Upper Limit:	Good	na
		Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:		Weight Factor:	0	Upper Limit:	Not Used	ac
		Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		***Area***		***Condition***		***Risk***		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
C-1 _81	>4:1	1	1260	2	Poor	3			6
C-1_82	>4:1	1	280	1	Poor	3			5
C-1_83	2:1 - 4:1	2	1484	2	Poor	3			7
C-1_84	>4:1	1	500	1	Medium	2			4
C-1_85	>4:1	1	2720	3	Poor	3			7
C-1_86	2:1 - 4:1	2	650	2	Medium	2			6
C-1_87	2:1 - 4:1	2	1250	2	Poor	3			7
C-2_01	>4:1	1	7600	3	Poor	3			7
C-2_02	>4:1	1	1800	2	Medium	2			5
C-2_03	2:1 - 4:1	2	375	1	Medium	2			5
C-2_04	>4:1	1	1400	2	Poor	3			6
C-2_05		2	2880	3	Poor	3			8
C-2_06	>4:1	1	4800	3	Poor	3			7
C-2_07	>4:1	1	6000	3	Poor	3			7
C-2_08	>4:1	1	6000	3	Poor	3			7
C-2_09	>4:1	1	1920	3	Poor	3			7
C-2_10		2	3180	3	Poor	3			8
C-2_11	>4:1	1	2080	3	Poor	3			7
C-2_12	>4:1	1	900	2	Poor	3			6
C-2_13	>4:1	1	1300	2	Poor	3			6

Table D-1. Kings Beach Ranking Table (continued)

	Relative Importance Factors		Ranking Class Definitions		
Slope:	Weight Factor:	1	Upper Limit:	<2:1	
	Relative Contribution:	33%	Lower Limit:	>4:1	
Area:	Weight Factor:	1	Upper Limit:	600	sf
	Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:	Weight Factor:	1	Upper Limit:	Good	na
	Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:	Weight Factor:	0	Upper Limit:	Not Used	ac
	Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		***Area***		***Condition***		***Risk***		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
C-2_14	>4:1	1	1200	2	Poor	3			6
C-2_54	>4:1	1	1902	3	Medium	2			6
C-2_55	>4:1	1	5900	3	Poor	3			7
C-2_56	>4:1	1	2980	3	Poor	3			7
C-2_57	>4:1	1	1040	2	Poor	3			6
C-2_58	>4:1	1	1170	2	Poor	3			6
C-2_59	>4:1	1	250	1	Poor	3			5
C-2_60	>4:1	1	3000	3	Poor	3			7
CC-1	<2:1	3	232	1	Good	1			5
CC-10	2:1 - 4:1	2	210	1	Good	1			4
CC-2	<2:1	3	96	1	Medium	2			6
CC-3	2:1 - 4:1	2	140	1	Medium	2			5
CC-4	2:1 - 4:1	2	394	1	Poor	3			6
CC-5	>4:1	1	570	1	Poor	3			5
CC-6	2:1 - 4:1	2	420	1	Poor	3			6
CC-7	>4:1	1	1278	2	Poor	3			6
CC-8	2:1 - 4:1	2	7000	3	Poor	3			8
CC-9	2:1 - 4:1	2	6000	3	Poor	3			8
Deer Basin									
D-1_01	2:1 - 4:1	2	28	1	Medium	2			5
D-1_02	>4:1	1	272	1	Medium	2			4

Table D-1. Kings Beach Ranking Table (continued)

	Relative Importance Factors		Ranking Class Definitions		
Slope:	Weight Factor:	1	Upper Limit:	<2:1	
	Relative Contribution:	33%	Lower Limit:	>4:1	
Area:	Weight Factor:	1	Upper Limit:	600	sf
	Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:	Weight Factor:	1	Upper Limit:	Good	na
	Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:	Weight Factor:	0	Upper Limit:	Not Used	ac
	Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		***Area***		***Condition***		***Risk***		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
D-1_03	>4:1	1	400	1	Medium	2			4
D-1_04	>4:1	1	50	1	Medium	2			4
D-1_05	>4:1	1	40	1	Medium	2			4
D-1_06	<2:1	3	6050	3	Medium	2			8
D-1_07	>4:1	1	24	1	Medium	2			4
D-1_08	>4:1	1	200	1	Poor	3			5
D-1_09	>4:1	1	600	1	Poor	3			5
D-1_10	>4:1	1	10	1	Medium	2			4
D-1_11	>4:1	1	480	1	Medium	2			4
D-1_12	>4:1	1	8400	3	Medium	2			6
D-1_13	>4:1	1	525	1	Poor	3			5
D-1_14	>4:1	1	1300	2	Medium	2			5
D-1_15	2:1 - 4:1	2	1500	2	Medium	2			6
D-1_16	>4:1	1	12000	3	Medium	2			6
D-1_17	>4:1	1	7500	3	Poor	3			7
D-1_18	>4:1	1	1950	3	Poor	3			7
D-1_19	>4:1	1	120	1	Poor	3			5
D-1_20	>4:1	1	3600	3	Poor	3			7
D-1_21	>4:1	1	1260	2	Medium	2			5
D-1_22	<2:1	3	350	1	Medium	2			6

Table D-1. Kings Beach Ranking Table (continued)

	Relative Importance Factors		Ranking Class Definitions		
Slope:	Weight Factor:	1	Upper Limit:	<2:1	
	Relative Contribution:	33%	Lower Limit:	>4:1	
Area:	Weight Factor:	1	Upper Limit:	600	sf
	Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:	Weight Factor:	1	Upper Limit:	Good	na
	Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:	Weight Factor:	0	Upper Limit:	Not Used	ac
	Relative Contribution:	0%	Lower Limit:	Not Used	ac

Problem ID#	*Slope* Average Slope	Slope Class, (1-3)	*Area* Estimated Area, ft^2	Area Class, (1-3)	*Condition* Cover/ Condition	Condition Class, (1-3)	*Risk* Tributary Area, ac	Hydro. Risk Class, (1-3)	Problem Ranking
D-1_23	>4:1	1	2150	3	Medium	2			6
D-1_24	2:1 - 4:1	2	1000	2	Medium	2			6
D-1_25	>4:1	1	2700	3	Poor	3			7
D-1_26	>4:1	1	12000	3	Poor	3			7
D-1_27	>4:1	1	2550	3	Poor	3			7
D-1_28	>4:1	1	1000	2	Poor	3			6
D-1_29	>4:1	1	300	1	Medium	2			4
D-1_30	>4:1	1	60	1	Medium	2			4
D-1_31	>4:1	1	11200	3	Medium	2			6
D-1_32	>4:1	1	960	2	Medium	2			5
D-1_33	>4:1	1	800	2	Poor	3			6
D-1_34	2:1 - 4:1	2	3000	3	Medium	2			7
D-1_35	<2:1	3	702	2	Medium	2			7
D-1_36	>4:1	1	5400	3	Poor	3			7
D-1_37	>4:1	1	680	2	Poor	3			6
D-1_38	>4:1	1	1680	2	Poor	3			6
D-1_39	>4:1	1	88	1	Poor	3			5
D-1_40	>4:1	1	8025	3	Poor	3			7
D-1_41	>4:1	1	4100	3	Poor	3			7
D-1_42	>4:1	1	7275	3	Poor	3			7

Table D-1. Kings Beach Ranking Table (continued)

	Relative Importance Factors		Ranking Class Definitions		
Slope:	Weight Factor:	1	Upper Limit:	<2:1	
	Relative Contribution:	33%	Lower Limit:	>4:1	
Area:	Weight Factor:	1	Upper Limit:	600	sf
	Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:	Weight Factor:	1	Upper Limit:	Good	na
	Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:	Weight Factor:	0	Upper Limit:	Not Used	ac
	Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		***Area***		***Condition***		***Risk***		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
D-1_43	>4:1	1	2800	3	Poor	3			7
D-1_44	>4:1	1	560	1	Medium	2			4
D-1_45	>4:1	1	1680	2	Medium	2			5
D-1_46	>4:1	1	5850	3	Medium	2			6
D-1_47	>4:1	1	5850	3	Medium	2			6
D-1_48	>4:1	1	870	2	Medium	2			5
D-1_49	>4:1	1	6400	3	Poor	3			7
D-1_50	>4:1	1	7200	3	Medium	2			6
D-1_51	>4:1	1	7200	3	Medium	2			6
D-1_52	>4:1	1	225	1	Medium	2			4
D-1_53	>4:1	1	2940	3	Medium	2			6
D-1_54	>4:1	1	3920	3	Medium	2			6
D-1_55	>4:1	1	400	1	Medium	2			4
D-1_56	>4:1	1	1200	2	Medium	2			5
D-1_57	>4:1	1	10000	3	Medium	2			6
D-1_58	>4:1	1	960	2	Poor	3			6
D-1_59	>4:1	1	8000	3	Medium	2			6
D-1_60	>4:1	1	8000	3	Poor	3			7
Fox Basin									
F-1_01	2:1 - 4:1	2	846	2	Good	1			5
F-1_02	<2:1	3	102	1	Poor	3			7

Table D-1. Kings Beach Ranking Table (continued)

		Relative Importance Factors		Ranking Class Definitions		
Slope:		Weight Factor:	1	Upper Limit:	<2:1	
		Relative Contribution:	33%	Lower Limit:	>4:1	
Area:		Weight Factor:	1	Upper Limit:	600	sf
		Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:		Weight Factor:	1	Upper Limit:	Good	na
		Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:		Weight Factor:	0	Upper Limit:	Not Used	ac
		Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		*Area*		*Condition*		*Risk*		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
F-1_03	2:1 - 4:1	2	627	2	Medium	2			6
F-1_04	<2:1	3	200	1	Medium	2			6
F-1_05	>4:1	1	220	1	Good	1			3
F-1_06	2:1 - 4:1	2	5345	3	Medium	2			7
F-1_07	<2:1	3	2555	3	Medium	2			8
F-1_08	>4:1	1	1155	2	Poor	3			6
F-1_09	2:1 - 4:1	2	1248	2	Poor	3			7
F-1_10	2:1 - 4:1	2	550	1	Poor	3			6
F-1_11	2:1 - 4:1	2	880	2	Poor	3			7
F-1_12	2:1 - 4:1	2	1350	2	Medium	2			6
F-1_13	2:1 - 4:1	2	2208	3	Poor	3			8
F-1_14	2:1 - 4:1	2	3824	3	Poor	3			8
F-1_15	>4:1	1	1470	2	Poor	3			6
F-1_16	2:1 - 4:1	2	4050	3	Poor	3			8
F-1_17	<2:1	3	6750	3	Poor	3			9
F-1_18	2:1 - 4:1	2	2205	3	Medium	2			7
F-1_19	>4:1	1	424	1	Medium	2			4
F-1_20	>4:1	1	1305	2	Medium	2			5
F-1_21	<2:1	3	11200	3	Medium	2			8
F-1_22	>4:1	1	1810	2	Poor	3			6

Table D-1. Kings Beach Ranking Table (continued)

	Relative Importance Factors		Ranking Class Definitions		
Slope:	Weight Factor:	1	Upper Limit:	<2:1	
	Relative Contribution:	33%	Lower Limit:	>4:1	
Area:	Weight Factor:	1	Upper Limit:	600	sf
	Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:	Weight Factor:	1	Upper Limit:	Good	na
	Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:	Weight Factor:	0	Upper Limit:	Not Used	ac
	Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		***Area***		***Condition***		***Risk***		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
F-1_23	>4:1	1	375	1	Poor	3			5
F-1_24	2:1 - 4:1	2	1895	2	Poor	3			7
F-1_25	>4:1	1	600	1	Poor	3			5
F-1_26	>4:1	1	5250	3	Poor	3			7
F-1_27	>4:1	1	600	1	Poor	3			5
F-1_28	>4:1	1	3330	3	Poor	3			7
F-1_29	>4:1	1	3520	3	Poor	3			7
F-1_30	>4:1	1	2500	3	Poor	3			7
F-2_01	>4:1	1	6600	3	Poor	3			7
F-2_02	>4:1	1	6300	3	Poor	3			7
F-2_03	>4:1	1	1200	2	Poor	3			6
F-2_04	>4:1	1	1200	2	Poor	3			6
F-2_05	>4:1	1	1800	2	Poor	3			6
F-2_06	>4:1	1	600	1	Poor	3			5
F-2_07	>4:1	1	1800	2	Poor	3			6
F-2_08	>4:1	1	7800	3	Poor	3			7
Griff Basin									
G-3_01	<2:1	3	500	1	Medium	2			6
G-3_02	>4:1	1	69	1	Poor	3			5
G-3_03	2:1 - 4:1	2	120	1	Medium	2			5
G-3_04	<2:1	3	889	2	Good	1			6

Table D-1. Kings Beach Ranking Table (continued)

	Relative Importance Factors		Ranking Class Definitions		
Slope:	Weight Factor:	1	Upper Limit:	<2:1	
	Relative Contribution:	33%	Lower Limit:	>4:1	
Area:	Weight Factor:	1	Upper Limit:	600	sf
	Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:	Weight Factor:	1	Upper Limit:	Good	na
	Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:	Weight Factor:	0	Upper Limit:	Not Used	ac
	Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		***Area***		***Condition***		***Risk***		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
G-3_05	<2:1	3	1000	2	Medium	2			7
G-3_06	>4:1	1	2100	3	Medium	2			6
G-3_07	<2:1	3	1955	3	Medium	2			8
G-3_08	<2:1	3	2400	3	Good	1			7
G-3_09	<2:1	3	1888	2	Poor	3			8
G-3_10	<2:1	3	856	2	Poor	3			8
G-3_11	2:1 - 4:1	2	616	2	Medium	2			6
G-3_12	>4:1	1	788	2	Medium	2			5
G-3_13	>4:1	1	350	1	Medium	2			4
G-3_14	<2:1	3	1200	2	Medium	2			7
G-3_15	>4:1	1	1495	2	Good	2			5
G-3_16	<2:1	3	3120	3	Good	1			7
G-3_17	<2:1	3	468	1	Medium	2			6
G-3_18	>4:1	1	5880	3	Poor	3			7
G-3_19	<2:1	3	840	2	Medium	2			7
G-3_20	>4:1	1	840	2	Poor	3			6
G-3_21	<2:1	3	2520	3	Good	1			7
G-3_22		2		1	Good	1			4
Park Basin									
P-1-01	<2:1	3	528	1	Medium	2			6
P-1-02	<2:1	3	1110	2	Medium	2			7

Table D-1. Kings Beach Ranking Table (continued)

	Relative Importance Factors		Ranking Class Definitions		
Slope:	Weight Factor:	1	Upper Limit:	<2:1	
	Relative Contribution:	33%	Lower Limit:	>4:1	
Area:	Weight Factor:	1	Upper Limit:	600	sf
	Relative Contribution:	33%	Lower Limit:	1902	sf
Condition:	Weight Factor:	1	Upper Limit:	Good	na
	Relative Contribution:	33%	Lower Limit:	Poor	na
Risk:	Weight Factor:	0	Upper Limit:	Not Used	ac
	Relative Contribution:	0%	Lower Limit:	Not Used	ac

	Slope		***Area***		***Condition***		***Risk***		
Problem ID#	**Average Slope**	**Slope Class, (1-3)**	**Estimated Area, ft^2**	**Area Class, (1-3)**	**Cover/ Condition**	**Condition Class, (1-3)**	**Tributary Area, ac**	**Hydro. Risk Class, (1-3)**	**Problem Ranking**
P-1-03	<2:1	3	525	1	Medium	2			6
P-1-04	<2:1	3	150	1	Medium	2			6
P-1-05	<2:1	3	2070	3	Medium	2			8
P-1-06	<2:1	3	1200	2	Medium	2			7
P-1-07	<2:1	3	3000	3	Medium	2			8
P-1-08	<2:1	3	2497	3	Medium	2			8
P-1-09	<2:1	3	240	1	Medium	2			6
P-1-10	<2:1	3	1000	2	Medium	2			7
P-1-11	<2:1	3	1410	2	Medium	2			7
P-1-12	<2:1	3	2470	3	Medium	2			8
Secline Basin									
S-01	<2:1	3	2250	3	Medium	2			8
S-02	<2:1	3	1200	2	Poor	3			8
S-03	<2:1	3	3600	3	Medium	2			8

Appendix E

Comment/Response Table for the TAC Draft Hydrology Report

Forward from:

"Dan LaPlante" <DLaplant@placer.ca.gov>

09/27/2005 05:00 PM MST

one from TRPA...go JP

>>> "Jon-Paul Harries" <jharries@trpa.org> 9/27/2005 4:59 PM >>>

Hi Dan,

Below are TRPA comments on the Draft Hydrologic Report for Kings Beach:

W1-1 Pg. 2 The document should separate out what areas are actual watersheds with perennial (and ephemeral) flows from the intervening zones that are not watershed, but urban runoff - I would assume a higher pollutant loads in the intervening urban areas.

W1-2 Pg. 4 How complete was the field verification of impervious areas? Do the outfalls include the Caltrans outfalls?

W1-3 Pg. 5 Land use should be broken down more: commercial vs. tourist accommodation vs. beach recreation. Where is there is open space between the beach and the highway? All uses should be shown on maps which could be referenced in the last paragraph.

W1-4 Table 2.1 Would like to see the percentage of forest vs.Urban area in each watershed. As presented it is difficult to distinguish differences between the watersheds.

W1-5 Pg. 10 To address the connectivity issue, it would be helpful to know the percentage (and possibly locations) of parcels with BMPs already installed. Also, is it safe to assume all rooftop drainage areas should be included in the k1 parameter since many rooftops drain to driveways and may not be captured by landscaping.

W1-6 Pg. 13 Similar to our comments on page 5, it would be beneficial to break out land uses to finer scale including tourist accommodation and beach recreation - also vacant areas should be identified as forested or beach.

W1-7 Pg. 15 Does the model consider rain on snow events? If so, how is it handled?

W1-8 Pg. 20 Explain flow routing. What is the relationship of runoff volume to peak discharge?

If you have questions, please give me a call.

Best, JP

p.s. For what its worth, I felt Dave's hydrologic analysis and write-up that he did for the Brockway Residential project was superior to this one in that it was very clear where and how he acquired the data, how it was analyzed, and what conclusions could be drawn from the information.
I would recommend using it as a model for future projects.

Comments on the Kings Beach Watershed Improvement Project
September 23, 2005
Sean Penders

W2-1 1. The document lacks references for many assumptions.

W2-2 2. Page 4, need reference on water quality information.

W2-3 3. Page 14, a pollutant load is given, but how that information was obtained in not clear, need to backup the pollutant loads with flows and concentrations, percentage of pollutant by source.

W2-4 4. Page 35 states sand application rates for county and state highways, yet the loads removed are not included. This is misleading and would lead to overestimating the contribution from this source.

W2-5 5. There is reference to water quality BMPs is there going to be a follow on document that explores this issue?

Comments on the Kings Beach Watershed Improvement Project
September 28, 2005
Cameron Knudson

W3-1 1. Page 12, Mean Annual Precipitation stated to be 26 inches. Should be between 30 inches to 40 inches. (35 inches)

W3-2 2. Page 21 discusses the classification of the sub-basins as "upper, middle, and lower". The drawings in appendix E are labeled "North, Middle, and South". Should these be labeled the same?

I. General Comments:

W4-1 It is clear a lot of good work went into the fieldwork and analyses presented in the hydrologic conditions report. The data and information clearly demonstrate the complexity of challenges that exist in the Kings Beach watershed. I am a bit surprised by the lack of recent and/or area specific data. For example, the soils information is based on NRCS work from 1974 and there is no watershed specific water quality data. Given the magnitude and complexity of the project area, we might want to consider investing in the collection of watershed specific data for some key constituents.

W4-2 Overall, I think the data and information presented in the subject report should be combined with the identification of opportunities and constraints. This combined information should then be used to identify underlying strategies that will guide us in the formulation of alternatives. I suggest some additional analyses in the specific comments below that might assist us in efforts to develop strategies for storm water quality improvements in the Kings Beach watershed.

W4-3 Given the complexity of the Kings Beach project area and the numerous reports that already exist, I wonder if it wouldn't be prudent to prepare some sort of executive summary or overview existing conditions document? It would be very helpfu to have one, relatively short document that identifies the project goals and objectives, provides a basic overview of the project area, and summarizes the results of the various existing conditions analyses.

II. Specific Comments:

W4-4

1. Pages 9 –13, Sections 2.2.3 – 2.4. The data and information on impervious area, infiltration rates, impervious connectivity, average annual flow rates, and pollutant loading are all presented by watershed sub-basin. In contrast, modeling results for runoff volume and peak flows are presented for "smaller basins," that is sub-areas within the sub-basins. I think presenting the runoff volume and flow data at a spatial scale that differs from the land use and pollutant loading data limits our ability to synthesize and understand these different sets of data. I recommend using one common spatial scale for all of the data. Given the complexity of the project area, breaking the information down by sub-area seems most attractive; however, I realize cost is an important constraint.

W4-5

2. Page 13, Section 2.4 Pollutant Loading. This section presents data on four different types of land use present in the Kings Beach watershed. This information is then used to estimate pollutant loads based on the generic concentrations provided in the FEA document. I strongly recommend you add highways as a fifth land use category. It is not clear if highways are incorporated into some other land use category. Information provided on page 35 of the document suggests sand applied to the county roads (66-203 tons/yr) provides 2–6 times the amount of sediment from all other land uses combined (~ 32 tons/yr). If this information is correct, then the highways are a major source of pollutants in the project area. I recommend you look at the

Brockway Existing Conditions Memorandum for a good example of how highways were incorporated into the water quality analysis.

W4-6

3. An August 22, 2005 email from Carol Schupbach asks the Kings Beach TAC to “provide any recommendations on how pollutants should be described, prioritized, and used during evaluation.” I recommend describing pollutant sources at the same scale as the runoff volume data (i.e., the sub-area). Some of the initial work is already done on the matchline drawings and in Appendix D. What is really needed is and effort to sum-up the pollutant types/and sources for each sub-area. For example, how many square feet of eroded shoulder exist in Deer Creek sub-area D2? This information should then be used with information on opportunities and constraints (not presented) to identify viable strategies for water quality improvements in each sub-area. Some overall project strategies might be to: 1) reduce the volume of storm water discharged to the lake (emphasizes hydrologic control), or 2) maximize the effectiveness of existing storm water and BMP infrastructure. Some sort of ranking scheme is probably the best way to prioritize pollutant problem areas. Providing information about the opportunities and constraints to address the problem areas and the proposed design approach (i.e., source control, hydrologic control, and treatment) could also help in the evaluation.

W4-7

4. Pages 32-33, Tables 5.1 and 5.2. The categories of “Other” and “Potential Problem” identified in these tables are not very helpful. I have no way of knowing what “Other” really means when I look at the matchline drawings in Appendix E. I also recommend you separate pollutant sources from issues of hydrologic control (e.g., drainage problems).

W4-8

5. Page 34, Risk ranking. This section needs more thought and development. I think the underlying idea is to try and characterize the chances of a pollutant reaching Lake Tahoe. Connectivity is one factor in this, which will vary depending on the size of the storm event. Another factor includes proximity to the lake (sediment from an exposed slope south of highway 28 has a greater chance of reaching the lake compared to an exposed slope at the top of the Griff Creek watershed). Disturbance might be another factor: an exposed road shoulder continually disturbed by parking is probably a greater risk than an exposed road shoulder where parking does not occur.

Table E-1. Comment Response Table.

Comment Number	Agency or Individual /Date	Comment	Response to Comment
W1-1	Jon-Paul Harries TRPA 9/27/05	Pg. 2 The document should separate out what areas are actual watersheds with perennial (and ephemeral) flows from the intervening zones that are not watershed, but urban runoff - I would assume a higher pollutant loads in the intervening urban areas.	The text has been changed to reflect that the Griff Creek watershed has a perennial stream flow and the Kings Beach Watershed has an ephemeral flow. The intervening zones (urban areas) are contained in both watersheds.
W1-2	Jon-Paul Harries TRPA 9/27/05	Pg. 4 How complete was the field verification of impervious areas? Do the outfalls include the Caltrans outfalls?	The impervious area was based on the IKONOS satellite image developed by Desert Research Institute of the Lake Tahoe basin. This information was obtained from TRPA. All outfalls in the Project area are mapped. The outfall locations were based on field observations and improvement plans. The Caltrans drainage system was followed to the outlet points by observing the direction of the pipe network at each drop inlet.
W1-3	Jon-Paul Harries TRPA 9/27/05	Pg. 5 Land use should be broken down more: commercial vs. tourist accommodation vs. beach recreation. Where is there is open space between the beach and the highway? All uses should be shown on maps which could be referenced in the last paragraph.	The Project area land use designations are the four categories defined in the SWQIC 2004 pollutant loading program. Commercial and tourist accommodation were both assumed to be predominately impervious surface with a substantial traffic ingress and egress. The open space refers to open parcels and open areas around homes.
W1-4	Jon-Paul Harries TRPA 9/27/05	Table 2.1 Would like to see the percentage of forest vs. urban area in each watershed. As presented it is difficult to distinguish differences between the watersheds.	The reference to forest is the U.S. Forest Service land to the north of Speckled Ave. and east of Beaver/Park Street. The table has been modified to reflect the ownership.
W1-5	Jon-Paul Harries TRPA 9/27/05	Pg. 10 To address the connectivity issue, it would be helpful to know the percentage (and possibly locations) of parcels with BMPs already installed. Also, is it safe to assume all rooftop drainage areas should be included in the k1 parameter since many rooftops drain to driveways and may not be captured by landscaping.	The parameters of the SWQIC spreadsheet were estimated from field evaluation of the site conditions. Because the spreadsheet is a lumped-parameter model, the coefficients also reflect this level of sensitivity. Specific residential BMP certificates are included based on the field observations of runoff patterns.

Table E-1. Comment Response Table (continued).

Comment Number	Agency or Individual /Date	Comment	Response to Comment
W1-6	Jon-Paul Harries TRPA 9/27/05	Pg. 13 Similar to our comments on page 5, it would be beneficial to break out land uses to finer scale including tourist accommodation and beach recreation - also vacant areas should be identified as forested or beach.	The SWQIC-accepted methodology uses the four designations presented. Further division will not improve the methodology.
W1-7	Jon-Paul Harries TRPA 9/27/05	Pg. 15 Does the model consider rain on snow events? If so, how is it handled?	The scope of this report requested that modeling assume spring/summer conditions and not rain on snow events. However, rain on snow events will be modeled at a later date when flood conveyance is addressed with the alternatives evaluation, as per the requirements of the Placer County Stormwater Management Manual.
W1-8	Jon-Paul Harries TRPA 9/27/05	Pg. 20 Explain flow routing. What is the relationship of runoff volume to peak discharge?	Flow routing is the numerical process of translating a hydrograph across the ground or through a channel. The peak discharge is the largest flow value in the runoff hydrograph. The volume is the area of the hydrograph. The peak flow and runoff volume are related by the excess precipitation (rainfall minus infiltration and other losses).
W2-1	Sean Penders Caltrans 9/23/05	The document lacks references for many assumptions.	References and assumptions have been added to the report as needed.
W2-2	Sean Penders Caltrans 9/23/05	Page 4, need reference on water quality information.	The SWQIC spreadsheet has been referenced.
W2-3	Sean Penders Caltrans 9/23/05	Page 14, a pollutant load is given, but how that information was obtained in not clear, need to backup the pollutant loads with flows and concentrations, percentage of pollutant by source.	The water quality results were derived from the SWQIC spreadsheet. This reference has been added.

Table E-1. Comment Response Table (continued).

Comment Number	Agency or Individual /Date	Comment	Response to Comment
W2-4	Sean Penders Caltrans 9/23/05	Page 35 states sand application rates for county and state highways, yet the loads removed are not included. This is misleading and would lead to overestimating the contribution from this source.	The amount of sand removed by Caltrans each year ranges from 117 tons to 521 tons. Therefore, a 92 percent average recovery based on the last four years will be used. County sand recovery efficiency ranges from 40-60 percent.
W2-5	Sean Penders Caltrans 9/23/05	There is reference to water quality BMPs is there going to be a follow on document that explores this issue?	The Review of Alternatives Memorandum will describe potential alternatives to address identified water quality problems. The alternatives will include different BMP's.
W3-1	Cameron Knudson Caltrans 9/28/05	Page 12, Mean Annual Precipitation stated to be 26 inches. Should be between 30 inches to 40 inches. (35 inches)	The Mean Annual Precipitation was based on an isohytal map developed by the Spatial Climate Analysis Service at Oregon State University. The reference has been added. The MAP was based on the lower urbanized watershed area because this is the primary pollutant generating area.
W3-2	Cameron Knudson Caltrans 9/28/05	Page 21 discusses the classification of the sub-basins as "upper, middle, and lower". The drawings in appendix E are labeled "North, Middle, and South". Should these be labeled the same?	The upper, middle, lower classification was performed for disaggregation of rainfall depths for the hydrologic model only. The north, middle, and south designation on the map refers to the section of the Griff Creek watershed that the map covers. Although the two designations roughly describe the same areas of the watershed, each was created for a specific use.
W4-1	Zach Hymanson CTC 9/27/05	It is clear a lot of good work went into the fieldwork and analyses presented in the hydrologic conditions report. The data and information clearly demonstrate the complexity of challenges that exist in the Kings Beach watershed. I am a bit surprised by the lack of recent and/or area specific data. For example, the soils information is based on NRCS work from 1974 and there is no watershed specific water quality data. Given the magnitude and complexity of the project area, we might want to consider investing in the collection of watershed specific data for some key constituents.	The 1974 soil survey is the last published copy of the soils in the area. Currently NCRS is updating soil survey around the country, but the Tahoe Basin survey has not been updated. Some site-specific data are available from studies performed by the Tahoe Research Group on the Coon Street basin. These data may be used during design. The TAC-approved work plan did not indicate a need for any additional pre-project monitoring.

Table E-1. Comment Response Table (continued).

Comment Number	Agency or Individual /Date	Comment	Response to Comment
W4-2	Zach Hymanson CTC 9/27/05	Overall, I think the data and information presented in the subject report should be combined with the identification of opportunities and constraints. This combined information should then be used to identify underlying strategies that will guide us in the formulation of alternatives. I suggest some additional analyses in the specific comments below that might assist us in efforts to develop strategies for storm water quality improvements in the Kings Beach watershed.	Comment noted.
W4-3	Zach Hymanson CTC 9/27/05	Given the complexity of the Kings Beach project area and the numerous reports that already exist, I wonder if it wouldn't be prudent to prepare some sort of executive summary or overview existing conditions document? It would be very helpfu to have one, relatively short document that identifies the project goals and objectives, provides a basic overview of the project area, and summarizes the results of the various existing conditions analyses.	An Executive Summary will be added to the final document.
W4-4	Zach Hymanson CTC 9/27/05	Pages 9 –13, Sections 2.2.3 – 2.4. The data and information on impervious area, infiltration rates, impervious connectivity, average annual flow rates, and pollutant loading are all presented by watershed sub-basin. In contrast, modeling results for runoff volume and peak flows are presented for "smaller basins," that is sub-areas within the sub-basins. I think presenting the runoff volume and flow data at a spatial scale that differs from the land use and pollutant loading data limits our ability to synthesize and understand these different sets of data. I recommend using one common spatial scale for all of the data. Given the complexity of the project area, breaking the information down by sub-area seems most attractive; however, I realize cost is an important constraint.	The watershed modeling (Section 3) was based on a smaller spatial scale than the pollutant load modeling used in the SWQIC spreadsheets (Section 2). This was done to allow the watershed model to capture features such as detention basins and channels. The results of the watershed model, presented in Tables 3.4 and 3.5, show the smaller subbasin units but also the totals for entire watershed so that comparisons of the two output sets can be made.

Table E-1. Comment Response Table (continued).

Comment Number	Agency or Individual /Date	Comment	Response to Comment
W4-5	Zach Hymanson CTC 9/27/05	Page 13, Section 2.4 Pollutant Loading. This section presents data on four different types of land use present in the Kings Beach watershed. This information is then used to estimate pollutant loads based on the generic concentrations provided in the FEA document. I strongly recommend you add highways as a fifth land use category. It is not clear if highways are incorporated into some other land use category. Information provided on page 35 of the document suggests sand applied to the county roads (66-203 tons/yr) provides 2–6 times the amount of sediment from all other land uses combined (~ 32 tons/yr). If this information is correct, then the highways are a major source of pollutants in the project area. I recommend you look at the Brockway Existing Conditions Memorandum for a good example of how highways were incorporated into the water quality analysis.	In the current SWQIC spreadsheet model format, there is a limit of four land use categories. For this analysis, highways were not separated out. The highways were incorporated into the commercial designation of the four land uses in the spreadsheet. The application rate of road sand is misleading, as the recovery efficiency of applied sand ranges from 40-60% for the County to approximately 90% for Caltrans (State Route 28).

Table E-1. Comment Response Table (continued).

Comment Number	Agency or Individual /Date	Comment	Response to Comment
W4-6	Zach Hymanson CTC 9/27/05	An August 22, 2005 email from Carol Schupbach asks the Kings Beach TAC to "provide any recommendations on how pollutants should be described, prioritized, and used during evaluation." I recommend describing pollutant sources at the same scale as the runoff volume data (i.e., the sub-area). Some of the initial work is already done on the matchline drawings and in Appendix D. What is really needed is and effort to sum-up the pollutant types/and sources for each sub-area. For example, how many square feet of eroded shoulder exist in Deer Creek sub-area D2? This information should then be used with information on opportunities and constraints (not presented) to identify viable strategies for water quality improvements in each sub-area. Some overall project strategies might be to: 1) reduce the volume of storm water discharged to the lake (emphasizes hydrologic control), or 2) maximize the effectiveness of existing storm water and BMP infrastructure. Some sort of ranking scheme is probably the best way to prioritize pollutant problem areas. Providing information about the opportunities and constraints to address the problem areas and the proposed design approach (i.e., source control, hydrologic control, and treatment) could also help in the evaluation.	The problems described in Appendix C are described at the subbasin level, similar to that used in the watershed model (Section 3). The pollutant sources identified for the development of the existing conditions are specified as the type of problem and the approximate location. Additional detail relating to specific size and location relative to the right-of-way, will be determined for project implementation. This report is the existing conditions, the development of alternatives is presented in the review alternatives memorandum.
W4-7	Zach Hymanson CTC 9/27/05	Pages 32-33, Tables 5.1 and 5.2. The categories of "Other" and "Potential Problem" identified in these tables are not very helpful. I have no way of knowing what "Other" really means when I look at the matchline drawings in Appendix E. I also recommend you separate pollutant sources from issues of hydrologic control (e.g., drainage problems).	Please see Appendix C for a description of the problem areas. The source control issues have been separated from the treatment and hydrologic control issues.

Table E-1. Comment Response Table (continued).

Comment Number	Agency or Individual /Date	Comment	Response to Comment
W4-8	Zach Hymanson CTC 9/27/05	Page 34, Risk ranking. This section needs more thought and development. I think the underlying idea is to try and characterize the chances of a pollutant reaching Lake Tahoe. Connectivity is one factor in this, which will vary depending on the size of the storm event. Another factor includes proximity to the lake (sediment from an exposed slope south of highway 28 has a greater chance of reaching the lake compared to an exposed slope at the top of the Griff Creek watershed). Disturbance might be another factor: an exposed road shoulder continually disturbed by parking is probably a greater risk than an exposed road shoulder where parking does not occur.	Ranking categories of slope, area, condition, and risk were used to compare the source areas against each other. These four categories describe the extent of the problem (area), chance of runoff (slope), current state of the soil and cover (condition), and the connection of the problem via the tributary area (risk). These four categories provide a reasonable method of categorizing the runoff. The factors mentioned in the comment are directly or indirectly addressed in the four factors used. For example, the comment mentions disturbance. This factor is covered in the category called condition.

Appendix F

Detailed Drainage and Source Area Maps (See attached CD)